7/1/06-03952

Final

Record of Decision
Operable Unit No. 16 (Site 93)

Marine Corps Base
Camp Lejeune, North Carolina

Prepared for

Department of the Navy
Naval Facilities Engineering Command
Mid-Atlantic Division
Norfolk, Virginia

Contract No. N62470-02-D-3052
CTO-0105

July 2006

Prepared by

CH2MHILL

7/1/06-03952

QC Review Page

Record of Decision

OU No. 16, Site 93

MCB Camp Lejeune

Jacksonville, North Carolina

Contract Task Order Number - 105
Contract Number N62470-02-D-3052
Navy CLEAN III Program

Prepared by

CH2M HILL

July 2006

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FINAL

Record of Decision
Operable Unit 16: Site 93
Marine Corps Base Camp Lejeune
Jacksonville, North Carolina

Department of the Navy
Naval Facilities Engineering Command
Mid Atlantic
Norfolk, Virginia

JULY 2006

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Acronyms and Abbreviations

ARAR	Applicable or Relevant and Appropriate Requirements
bgs	below ground surface
BRA	Baseline Risk Assessment
CDI	Chronic Daily Intake
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	Contaminant of Concern
COPC	Contaminant of Potential Concern
CSF	Carcinogenic Slope Factor
CSM	Conceptual Site Model
cVOC	Chlorinated Volatile Organic Compound
DCE	Dichloroethene
EPC	Exposure Point Concentration
ERA	Ecological Risk Assessment
FFA	Federal Facilities Agreement
FMF	Fleet Marine Force
FS	Feasibility Study
HDPE	High Density Polyethylene
HEAST	Health Effects Assessment Summary Table
HI	Hazard Index
HQ	Hazard Quotient
ICR	Incremental Lifetime Cancer Risk
IRIS	Integrated Risk Information System
IROD	Interim Record of Decision
IRP	Installation Restoration Program
LS	Lump Sum
LTM	Long-Term Monitoring
LUC	Land Use Control
MCB	Marine Corps Base
MCL	Maximum Contaminant Level
mg/kg-day	milligrams per kilogram per day
MNA	Monitored Natural Attenuation
msl	mean sea level
NAE	Natural Attenuation Evaluation
NAIP	Natural Attenuation Indicator Parameters
NCDENR	North Carolina Department of Environment and Natural Resources

NCEA	National Center for Environmental Assessment
NCGS	North Carolina General Statute
NCGWQS	North Carolina Groundwater Quality Standards
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
O&M	Operation and Maintenance
OU	Operable Unit
PCA	Tetrachloroethane
PCE	Tetrachloroethene
PRAP	Proposed Remedial Action Plan
PRB	Permeable Reactive Barrier
RAB	Restoration Advisory Board
RAO	Remedial Action Objective
RD	Remedial Design
RfD	Reference Dose
RI	Remedial Investigation
RME	Reasonable Maximum Exposure
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act
SMP	Site Management Plan
TBC	To-Be-Considered
TCE	Trichloroethene
TCL	Target Compound List
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank
VC	Vinyl Chloride
VOC	Volatile Organic Compound
ZVI	Zero Valent Iron

SECTION 1

Declaration

1.1 Site Name and Location

Site 93, Operable Unit 16
Marine Corps Base Camp Lejeune
Jacksonville, North Carolina
EPA ID#: NC6170022580

1.2 Statement of Basis and Purpose

This Record of Decision (ROD) presents the Selected Remedy for Site 93, Operable Unit (OU) 16, at Marine Corps Base (MCB) Camp Lejeune, in Jacksonville, North Carolina. OU 16 is comprised of Sites 89 and 93. Site 89 is currently in the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) Investigation Stage and will be completed at a later date; therefore, this ROD will serve as a final ROD for Site 93 and an Interim ROD (IROD) for OU 16. The remedy for Site 93 was selected in accordance with CERCLA, as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on information contained in the Administrative Record file for the site.

The United States Department of the Navy (Navy) is the lead agency and provides funding for site cleanups at MCB Camp Lejeune. The remedy set forth in this ROD has been selected by the Navy and MCB Camp Lejeune, together with the United States Environmental Protection Agency (USEPA), and with the concurrence of the North Carolina Department of Environment and Natural Resources (NCDENR). A copy of the NCDENR concurrence letter dated June 10, 2006, is included as **Appendix A**. NCDENR has also indicated concurrence with the Selected Remedy by signing this ROD.

1.3 Assessment of the Site

Previous investigations have identified the presence of chlorinated volatile organic compounds (cVOCs) in groundwater at concentrations that pose a potential threat to human health if used as a potable water supply. The response action selected in this ROD is necessary to protect the public health, welfare and/or the environment from actual or threatened releases of hazardous substances.

1.4 Description of the Selected Remedy

Site 93 is part of OU 16 and is one of several Installation Restoration Program (IRP) sites that are part of the comprehensive environmental investigation and cleanup currently being performed at MCB Camp Lejeune under the CERCLA program. This ROD only addresses Site 93. The status of all the IRP sites at MCB Camp Lejeune can be found in the current version of the Site Management Plan (SMP), which is located in the Administrative Record.

The Selected Remedy for Site 93 includes groundwater treatment through in situ chemical oxidation via permanganate injection, monitored natural attenuation (MNA), and land use controls (LUCs) that will limit exposure to groundwater and prohibit the use of groundwater except for monitoring. Long-term groundwater monitoring will be conducted and LUCs will be maintained on groundwater and associated property use within the boundaries of Site 93 until the concentrations of hazardous substances in the groundwater have been reduced to levels that allow for unlimited exposure and unrestricted use. It has been determined that no remedial action on Site 93 soil and surface water media is required for them to be suitable for unlimited use.

The Selected Remedy was determined based on the evaluation of site conditions, site related risks, applicable or relevant and appropriate requirements (ARARs), and remedial action objectives (RAOs). Once RAOs are achieved for the groundwater media, Site 93 will be suitable for unlimited use. The components of the Selected Remedy include:

- In situ chemical treatment of the highest concentration area of the plume
  - Injection of chemical oxidants (i.e., permanganate)
  - Injection through temporary boreholes of sufficient number and spacing for effective in situ groundwater treatment
  - Delivery of reagent via injection technology
- Groundwater monitoring and reporting to assess the progress of the remedy over time
- LUCs, as described in Section 2.12 of this ROD, to
  - Prohibit the withdrawal of groundwater except for environmental monitoring from the aquifers (surficial and Castle Hayne) within 1,000 feet of the groundwater plume, and
  - Prohibit intrusive activities within the extent of the current groundwater contamination unless specifically approved by both NCDENR and USEPA.
  - Maintain the integrity of any current or future remedial or monitoring system such as monitoring wells.
  - Specific types of LUCs to be employed for these purposes will include: 1) incorporating land use prohibitions into the MCB Camp Lejeune Base Master Plan; 2) a deed Notice of Inactive Hazardous Substance or Waste Disposal filed in Onslow County real property records per North Carolina General Statutes (NCGS) 130A-310.8; and 3) deed restrictions included in any deed transferring any portion of Site 93 to any non-Federal transferee.

The remedy's effectiveness will then be assessed during the next five year review scheduled for 2010. If the remedy is shown to be insufficient, other remedial approaches will be evaluated and may be implemented.

The Navy shall prepare, in accordance with USEPA guidance, and submit to the USEPA and NCDENR, a Remedial Design (RD) containing LUC implementation actions in accordance with the schedules in the Federal Facility Agreement (FFA). The Navy shall also submit the

document memorializing remedial action completion within 120 days following completion of the remedial action for Site 93.

LUCs shall be maintained until the concentrations of hazardous substances in the groundwater are at such levels as to allow for unlimited exposure and unrestricted use. The Navy will be responsible for implementing, maintaining, inspecting, reporting, and enforcing the LUCs described in this ROD in accordance with the approved RD.

1.5 Statutory Determinations

The Selected Remedy is protective of human health and the environment, complies with Federal and State requirements that are legally applicable or relevant and appropriate to the remedial action, is cost-effective, utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable, and satisfies the preference for treatment as a principle element of the remedy.

Because this remedy will result in pollutants or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted every five years after the initiation of the remedial action to ensure that the remedy continues to be protective of human health and the environment.

1.6 ROD Data Certification Checklist

The following information is included in the Decision Summary section of this ROD. Additional information can be found in the Administrative Record file for MCB Camp Lejeune, Site 93.

- Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of groundwater used in the baseline risk assessment and ROD (Section 2.6);
- Baseline risk represented by the COCs (Section 2.7);
- Contaminants of concern (COCs) and their respective concentrations (Section 2.7 and associated tables);
- Key factors that led to selecting the remedy (i.e., a description of how the Selected Remedy provides the best balance of tradeoffs with respect to the balancing and modifying criteria, highlighting criteria key to the decision) (Section 2.12.1);
- Estimated capital costs, annual operation and maintenance (O&M) costs, and total present-worth costs; discount rate, and the number of years over which the remedy costs are projected (Section 2.12.3 and Table 2-8);
- Cleanup levels established for COCs and the basis for these levels (Section 2.12.4); and
- Potential land and groundwater use that will be available at the site as a result of the Selected Remedy (Section 2.12.4).

1.7 Authorizing Signatures

A.E. Hodges
Colonel, U.S. Marine Corps
Commanding Officer
Marine Corps Base, Camp Lejeune

18 Sept 06
Date

Dexter R. Matthews, Director
Division of Waste Management
North Carolina Department of Environment and Natural Resources

9-22-06
Date

Beverly H. Banister, Acting Director
Waste Management Division
U.S. Environmental Protection Agency

10/2/06
Date

SECTION 2

Decision Summary

This ROD describes the Navy and USEPA's selected remedial action for Site 93 at MCB Camp Lejeune in Jacksonville, North Carolina. The Navy is the lead agency and provides funding for site cleanups. Site 93 is part of OU 16, which is one of twenty-two OUs at MCB Camp Lejeune.

The Public Meeting for Site 93 was held on February 16, 2006. The Preferred Alternative, as detailed in the Proposed Remedial Action Plan (PRAP), was presented at the meeting. The Decision Summary provides an overview of Site 93 characteristics and describes the process by which the Selected Remedy was chosen and then rationale for its selection. Community acceptance of the alternatives is discussed in Section 3.0 of this ROD. NCDENR concurs with the Selected Remedy. A copy of the NCDENR concurrence letter dated June 10, 2006 is included as **Appendix A**. NCDENR has also indicated concurrence with the Selected Remedy by signing this ROD.

2.1 Site Name, Location, and Background

MCB Camp Lejeune is located on 236 square miles of land in Onslow County, North Carolina, adjacent to the southern side of the City of Jacksonville (**Figure 2-1**). Jacksonville is the largest city near MCB Camp Lejeune and contains approximately half of the county's total population. Since 1990, much of the MCB Camp Lejeune complex has been part of Jacksonville. The Base is bisected by the New River, which flows into the Atlantic Ocean in a southeasterly direction. The Base is bordered by the Atlantic Ocean to the east, U.S. Route 17 to the west, and State Route 24 to the north. MCB Camp Lejeune is primarily industrial, but is also used for recreational, commercial, and residential purposes. The areas adjacent to the Base are generally rural.

MCB Camp Lejeune was commissioned in 1942 as a training area to prepare Marines for combat. The MCB Camp Lejeune complex consists of six geographical locations under the jurisdiction of the Base command. These areas include Camp Geiger, Montford Point, Courthouse Bay, Mainside, the Greater Sandy Run Area, and the Rifle Range Area.

Site 93 is located within Camp Geiger, which is located in the extreme northwest corner of the Base. Its main entrance is off of Route 17, about 3.5 miles southeast of the City of Jacksonville, North Carolina. Site 93 is located near Building TC-942 at the intersection of Ninth and "E" Streets (**Figure 2-2**). The buildings in this portion of Camp Geiger were constructed during the Korean War and currently function as classrooms, barracks, and supply rooms for the Marine Infantry School.

2.2 Site History and Enforcement Activities

Historical records indicate that a 550-gallon underground storage tank (UST) storing waste oil was previously located on Site 93, off the southwest corner of Building TC-942; however no documentation was available regarding the installation date of the UST. The UST was

permanently closed as part of a tank removal in December 1993, completed under the authority of the State of North Carolina's UST program. Based on elevated concentrations of oil and grease at the time of the tank removal, a release was suspected to have occurred. Upon removal of the tank, an investigation was conducted, which identified chlorinated solvents in the groundwater.

Investigations at Site 93 have been conducted since 1995 and have historically focused on the small area near the southwest corner of Building TC-942 that formerly contained the 550-gallon UST used to store waste oil. Over time, the investigations have expanded outward from TC-942. Site documentation is available to the public in the Administrative Record for MCB Camp Lejeune. The following subsections provide summaries of the previous investigations conducted at Site 93.

2.2.1 UST Investigation (1995)

A UST investigation was conducted to identify the nature and extent of contamination associated with the UST, which included the installation of five monitoring wells in the vicinity of the former UST excavation and the collection of soil and groundwater samples. During this investigation, chlorinated solvents were detected in soil and groundwater samples. Based on these results, Site 93 was transferred into the IRP and was recommended for additional study.

2.2.2 Geotechnical Investigation (1996)

Between 1995 and 1996, a geotechnical investigation and environmental screening were conducted near the barracks area, in the vicinity of Building G-920 (**Figure 2-2**). The environmental screening consisted of the installation and sampling of six temporary monitoring wells (installed in associated soil borings). Chlorinated solvent contamination was not observed in any of the soil borings located around Building G-920; however trace levels of chlorinated solvents were detected in groundwater samples collected from one temporary well.

2.2.3 Final Remedial Investigation, Operable Unit No. 16 (1996/1997)

From 1996 to 1997, a Remedial Investigation (RI) was conducted to characterize the nature and extent of soil and groundwater contamination at OU 16. Field activities included the installation of permanent and temporary monitoring wells and the collection of soil and groundwater samples analyzed for volatile organic compounds (VOCs). Once sampling activities were completed, all of the temporary wells were abandoned.

Soil analytical results for Site 93 indicated that soil had not been significantly impacted by site-related activities. Groundwater analytical results for Site 93 identified cVOC contamination (primarily trichloroethene [TCE]) concentrated in the surficial aquifer (less than 15 feet below ground surface [bgs]) within the immediate area of the former UST. VOCs were not detected in any groundwater samples collected from the upgradient locations around Building G-920. A cVOC groundwater plume was identified as generally extending from east of Building G-920 to "E" Street, between Ninth and Tenth streets. Groundwater analytical data also suggested contaminant discharge to Edwards Creek was occurring.

2.2.3.1 Baseline Risk Assessment

A detailed Baseline Risk Assessment (BRA) was conducted as part of the RI to evaluate the potential human health and/or environmental risks associated with the presence of potentially site-related constituents in subsurface soil and groundwater at Site 93. The BRA characterizes the current and potential future human health and/or environmental risks if no additional remediation is implemented. Health risks are based on a conservative estimate of the potential carcinogenic risk or the potential to cause other health effects not related to cancer (non-carcinogenic risk). A conservative estimate of risk was determined for potential exposure scenarios including future construction workers and future adult and child residents.

Data collected during the RI revealed that no unacceptable risks or hazards associated with subsurface soil exist based on current or future site uses, as potential cancer and non-cancer risks are within USEPA acceptable risk range.

The BRA for groundwater at Site 93 indicated that the risks posed to potential future receptors coming in contact with contaminants of potential concern (COPCs) via ingestion would most likely exceed USEPA's acceptable cancer risk range of 10^{-6} to 10^{-4} and non-cancer hazard index of 1.0. The COPCs contributing to unacceptable cancer risk are primarily tetrachloroethene (PCE) and arsenic, and the COPCs contributing to unacceptable non-cancer hazard include *cis*-1,2-dichloroethene (*cis*-1,2-DCE) and manganese.

The observed total metal concentrations (arsenic and manganese) in groundwater are typically due more to geologic conditions (i.e., naturally occurring metals bound to unconsolidated soil particles) and sample acquisition methods than to mobile metal concentrations in groundwater. The presence of these metals is suspected to be a result of existing natural conditions, and not site operations.

2.2.3.2 Ecological Risk Assessment

An ecological risk assessment (ERA) was performed during the RI in accordance with Federal, State, and Navy guidelines to identify and characterize the current and potential threats to the environment from Site 93. The ERA consisted of determining whether there are ecological receptors to protect based on the ecological setting, fate and transport of the COPCs, and any potentially complete pathways.

No ecological receptors were identified as being at risk for Site 93.

2.2.4 Long-Term Monitoring (1999)

Long-Term Monitoring (LTM) of the Site began in April 1999 and is on-going. Groundwater samples are collected from eight permanent on a semi-annual basis in order to fully assess plume stability. Groundwater samples collected under this program are analyzed for VOCs and natural attenuation indicator parameters (NAIP). The LTM results from October 2002 through September 2004 indicate that there is limited potential for natural attenuation of the chlorinated solvents; however, the process is being slowed or stalled as evidenced by increasing PCE concentrations in the "hottest" well, steady TCE concentrations, and limited detections of daughter compounds.

2.2.5 Natural Attenuation Evaluation (2001)

In 2001, a preliminary natural attenuation evaluation (NAE) was conducted to determine whether natural site conditions would encourage the natural attenuation process of degrading TCE. The results indicated limited natural attenuation of chlorinated solvents was occurring. However, the reductive dechlorination process appeared to be stalling, indicating that the reduced state of the aquifer is not enough to encourage optimal dechlorination.

2.2.6 Additional Plume Characterization (2002)

At the request of the Partnering Team, additional plume characterization/delineation activities were conducted in order to further delineate groundwater contamination at Site 93, characterize "hot spots", and provide additional data to support the selection of an active remedial system. Field activities included the installation of permanent monitoring wells and the collection of groundwater samples. The analytical results identified several "hot spot" areas. The primary plume appeared related to the former UST area, with smaller "hot spot" areas downgradient. The results indicated horizontal migration of groundwater contamination had been minimal since 1995; however, vertical migration was observed. During the RI, cVOC concentrations above North Carolina Groundwater Quality Standards (NCGWQS) were generally limited to a depth of 15 feet bgs; while in 2002, elevated levels of cVOCs were identified up to a depth of approximately 30 feet bgs, with impacts concentrated at 15 to 19 feet bgs.

2.2.7 Supplemental Site Investigation (2005)

From December 2004 through January 2005, a supplemental site investigation was conducted to determine the current conditions of groundwater contamination in the surficial aquifer, and collect additional data to support the selection of a remedial alternative. Groundwater samples were collected from boring locations at three depths, and analyzed for VOCs, iron, manganese, chloride, nitrate, nitrite, sulfate, methane, ethane, ethene, sulfide, total dissolved solids, and total suspended solids. Once the groundwater screening results were analyzed, additional permanent monitoring wells were installed in order to complete the horizontal and vertical delineation of the shallow groundwater contamination.

2.2.8 Final Feasibility Study (2005)

Based on the results of the RI, the Additional Plume Characterization and the Supplemental Site Investigation, a FS was completed to evaluate remedial action alternatives to address groundwater contamination at Site 93. A 200 foot by 100 foot target treatment area centered on the area of highest groundwater contamination was identified, and the remedial alternatives were then designed to focus on the treatment area, with long-term MNA conducted in the remainder of Site 93. The FS evaluated the following alternatives: no action, zero valent iron (ZVI) permeable reactive barrier (PRB), in situ chemical reduction via ZVI injection, in situ chemical oxidation via permanganate injection, and air sparging.

Further detailed information is contained in the Administrative Record for MCB Camp Lejeune. A complete list of the documents included in the Administrative Record files can

be obtained from the MCB Camp Lejeune Installation Restoration web site: http://bakerenv.com/camplejeune irp/default frameset.htm

2.2.9 Enforcement Activities

MCB Camp Lejeune was placed on USEPA's National Priorities List (NPL) effective November 4, 1989 (54 Federal Register 41015, October 4, 1989). As a result of the NPL listing and pursuant to CERCLA, the USEPA Region 4, NCDENR, the Navy, and the Marine Corps entered into a FFA for MCB Camp Lejeune in 1991. The primary purpose of the FFA is to ensure that the environmental impacts associated with past and present activities at the Base are thoroughly investigated. The IRP is responsible for ensuring that appropriate CERCLA response alternatives are developed and implemented as necessary to protect public health, welfare, and the environment. No enforcement activities have been recorded at Site 93.

2.3 Community Participation

The Navy, MCB Camp Lejeune, USEPA, and NCDENR provide information regarding the cleanup of MCB Camp Lejeune to the public through the community relations program which includes a Restoration Advisory Board (RAB), public meetings, the Administrative Record file for the site, and announcements published in local newspapers. RAB meetings continue to be held to provide an information exchange among community members, the Navy, MCB Camp Lejeune, USEPA, and NCDENR. These meetings are open to the public and are held quarterly.

In accordance with Sections 113 and 117 of CERCLA, the Navy provided a public comment period from February 16 through March 16, 2006, for the PRAP for Site 93. A public meeting to present the PRAP was held on February 16, 2006, at the Carolina Coastal Community College. Public notice of the meeting and availability of documents was placed in *The Jacksonville Daily News* and *The Globe* newspapers on February 1, 2006 and February 2, 2006, respectively.

The Administrative Record, Community Relations Plan, Installation Restoration Program fact sheets, and final technical reports concerning Site 93 can be obtained from the IRP web site: http://bakerenv.com/camplejeune irp/default frameset.htm

Internet access is available to the public at the following location:

Onslow County Public Library
58 Doris Avenue East
Jacksonville, North Carolina 28540
(910) 455-7350

2.4 Scope and Role of Response Action

Site 93 is one of 95 IRP sites under CERCLA investigation at MCB Camp Lejeune. The response action for Site 93 does not include or affect any other sites at the facility. Information on the status of all the IRP sites at MCB Camp Lejeune can be found in the current version of the SMP, which is located in the Administrative Record.

The Selected Remedy in this ROD, groundwater treatment through in situ chemical oxidation via permanganate injection with MNA addresses all potential risks from cVOCs in groundwater and eliminates current and future exposure pathways. Throughout implementation of the remedy, LUCs will be maintained within the boundaries of Site 93 until the concentrations in groundwater have been reduced to levels that allow for unlimited exposure and unrestricted use. LUCs will be implemented by the Navy to meet the following objectives:

- Prohibit the withdrawal of groundwater except for environmental monitoring from the aquifers (surficial and Castle Hayne) within 1,000 feet of the groundwater plume, and
- Prohibit intrusive activities within the extent of the current groundwater contamination unless specifically approved by both NCDENR and USEPA until RAOs are achieved.

The Selected Remedy will be designed and implemented to meet State and Federal requirements. The Navy shall develop and submit to the USEPA and NCDENR for review and approval, in accordance with the FFA and the schedule in the SMP, an RD document that contains the Selected Remedy design and a LUC RD that shall provide for implementation and maintenance actions, including periodic inspections and reporting. The Navy will implement, maintain, monitor, report on, and enforce the LUCs according to the RD.

2.5 Site Characteristics

Site 93 is located within the Camp Geiger area of MCB Camp Lejeune near Building TC-942 south of Ninth Street, between "D" and E" streets. Surrounding water bodies include Edwards Creek located east and southeast of the site. There are no surface or subsurface features (i.e., tanks, structures) or areas of archaeological or historical importance at Site 93.

The ground surface at Site 93 is relatively flat and covered by asphalt, gravel, and grass. The eastern portion of the Site is wooded and slopes gently toward Edwards Creek. Ground surface elevations are approximately 5 to 20 feet above mean sea level (msl) in the vicinity of the site. Depth to groundwater in the surficial aquifer generally ranges from 7 to 14 feet above msl.

2.5.1 Conceptual Site Model

The source of cVOC contamination at Site 93 was likely due to a release from the UST storing waste oil. This release could have occurred from leaching through soil to the groundwater. The conceptual site model (CSM) for human health exposure pathways (**Figure 2-3**) shows transport pathways, exposure media, exposure routes, and potential human health receptors for Site 93. The BRA and the subsequent RAOs for Site 93 were based on this CSM. A CSM for ecological exposure pathways was not developed because no ecological receptors were identified as being at risk for Site 93.

As concluded in the ERA, there is minimal viable ecological habitat and a complete exposure pathway for ecological receptors does not exist. For human health, potential receptors, including future residents and future site workers, may contact any residual

levels of contamination in soil or groundwater through ingestion, inhalation, or dermal absorption.

2.5.2 Sampling Strategy

Subsurface soil and groundwater samples were collected and analyzed to characterize the nature and extent of contamination and potential risk to human health and the environment as part of the RI/BRA/ERA. The field activities for the RI were conducted in two phases; Phase I sampling was completed in 1996 and Phase II was completed in 1997. The Phase I and II field activities included the installation and sampling of permanent and temporary monitoring wells, the collection of subsurface soil samples, and water level monitoring. A summary of samples collected is provided as **Table 2-1**.

Additional groundwater samples were collected and analyzed to further characterize the horizontal and vertical extent of contamination as part of the Additional Plume Characterization. Field activities were conducted in 2002 and included the installation and sampling of monitoring wells, direct-push groundwater sampling, and the collection of soil samples for lithologic characterization. A summary of samples collected is provided as **Table 2-2**.

In 2004 and 2005, additional groundwater samples were collected and analyzed to further delineate groundwater contamination in the surficial aquifer as part of the Supplemental Site Investigation. The investigation included direct-push groundwater sampling and the installation and sampling of monitoring wells. A summary of samples collected is provided in **Table 2-3**.

2.5.3 Nature of Contamination

The principal COCs at Site 93 are PCE and its breakdown products (TCE, *cis*-1,2-DCE, vinyl chloride [VC]) and 1,1,2,2-tetrachloroethane (1,1,2,2-PCA). COCs and their maximum concentrations in groundwater at Site 93 are provided in **Table 2-4.** Site 93 groundwater contamination is comprised of a large, diffuse plume generally extending from west of "D" Street towards Edwards Creek, between Ninth and Tenth streets. The lateral extent of PCE and TCE contamination are illustrated on **Figures 2-4, 2-5, 2-6, and 2-7**, which depict an area of elevated cVOC concentration (i.e., concentration one or two orders of magnitude above NCGWQS) off the southeast corner of Building TC-942 at a depth of 6 to 16 feet bgs. An additional area of elevated cVOC concentration was identified from samples collected from a soil boring via direct push technology. However, this second area was restricted to the immediate vicinity of a single soil boring west of Building TC-942 at a depth of 18 to 22 feet bgs. The lateral extent of PCE and TCE contamination Analytical data indicate that groundwater continues to migrate horizontally in the direction of groundwater flow, and low level contaminant discharge may be impacting Edwards Creek. Historically, several COCs have been detected in surface water samples collected from the Creek; however it is not clear if these detections were attributable to Site 93 or Site 89 (**Figure 2-2**).

The vertical extent of groundwater contamination at Site 93 is generally limited to about 30 feet bgs, although low level VOCs have been detected at greater depths. Results of the Supplemental Site Investigation show that concentrations of cVOCs are highest at depths

less than 16 feet bgs. Based on available data, VOC contamination does not appear to be migrating vertically.

2.5.4 Current and Potential Future Surface and Subsurface Routes of Exposure and Receptors

The primary fate and contaminant migration pathway for cVOCs at Site 93 is through groundwater flow in the surficial aquifer. The mechanisms of transport include dissolution, advection, and dispersion. Analytical data collected in 2005 suggested that discharge of water from the shallow aquifer to Edwards Creek may be occurring.

The only groundwater withdrawals from Site 93 are for environmental monitoring. Until remedial actions reduce concentrations to levels that allow for unlimited exposure and unrestricted use, LUCs will prevent human or environmental exposure to groundwater.

2.5.5 Aquifer Characteristics

Site 93 is underlain by the surficial aquifer, comprised of loose to medium dense sands and soft to medium stiff clay. The water table ranges between approximately 8 and 13 feet above msl. The thickness of the surficial aquifer is approximately 18 to 23 feet. In general, the surficial aquifer appears to lie immediately above the Castle Hayne aquifer, with little to no presence of the Castle Hayne confining unit (Belgrade Formation). At best, the Belgrade Formation at Site 93 can be classified as a semi-confining unit or a "retarding layer" as it is laterally discontinuous and does not exhibit completely confining conditions. The Castle Hayne aquifer is predominantly composed of dense to very dense shell and fossil fragments interbedded with calcareous sands.

The inconsistent nature of the Belgrade Formation suggests that a significant hydraulic connection exists between the surficial aquifer and the upper portions of the Castle Hayne aquifer. Groundwater elevation data suggests that the flow patterns observed for the surficial aquifer and the upper portions of the Castle Hayne aquifer display similar trends. Groundwater flow within the surficial aquifer at Site 93 is generally to the east toward Edwards Creek, which serves as a groundwater discharge boundary. Groundwater flow in the upper portions of the Castle Hayne is affected somewhat by the local discharge area of Edwards Creek. The New River, located east of the site, apparently influences the groundwater flow of the deeper portion of the Castle Hayne aquifer, causing groundwater at depth to move east, toward the river.

Hydraulic conductivity at Site 93 is estimated to be similar to values at Site 89. During the RI, the average hydraulic conductivity in the surficial aquifer at Site 89 was 8.4 feet/day; and the average hydraulic conductivity in the Castle Hayne aquifer at Site 89 was 64.6 feet/day. The hydraulic gradient at Site 93 was estimated at approximately 0.004 feet/foot.

2.6 Current and Potential Future Site and Resource Uses

The buildings within the boundaries of Site 93 are currently used by the Base as supply rooms for the Marine Infantry School. The remainder of the site consists of asphalt, gravel, and grass. Residential, commercial, and administrative activities surround site. Current land uses are expected to continue at Site 93, and there is no other planned future land use. LUCs will be implemented within the boundaries of the site to eliminate exposure to shallow

groundwater until the remedial action reduces concentrations to levels that allow for unrestricted use.

MCB Camp Lejeune potable water is supplied entirely from groundwater, which is obtained from approximately 90 water supply wells. However, groundwater is not currently used as a potable water supply at or in the vicinity of Site 93. The closest water supply well is located approximately two-fifths of a mile south of Site 93.

2.7 Site Risks

A BRA and ERA were conducted to evaluate the potential human health and/or environmental risks associated with the presence of potentially site-related constituents in subsurface soil and groundwater at Site 93. The risk assessments characterize the current and potential future risks at the site if no additional remediation is implemented. They provide the basis for taking action and identify the contaminant and exposure pathways that need to be addressed by the remedial action. A detailed discussion of potential risks is provided in the RI/BRA/ERA (Baker Environmental, 1998). Shallow groundwater poses the only potential unacceptable risk to human health or the environment at Site 93. The response action selected in this ROD is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

2.7.1 Human Health Risk Summary

The source of potential human health risk is shallow groundwater contamination attributed to the presence of cVOCs. A detailed discussion of risks identified at Site 93 can be found in the RI Report (Baker, 1998). There is no potential human health risk associated with site-related releases to soil.

2.7.1.1 Chemicals of Concern

COCs in groundwater at Site 93 are identified on **Table 2-4**. Detailed information for the selection of COPC for all media at Site 93 is provided in Section 6.2 of the RI (Baker Environmental, 1998). The exposure point concentration (EPC) used to estimate the risk for COCs is provided in **Table 2-5.**

2.7.1.2 Exposure Assessment

The human health exposure assessment identifies and evaluates the contaminant sources, release mechanisms, exposure pathways, exposure routes, and receptors. The elements of the exposure assessment for Site 93 are identified in the CSM (**Figure 2-3**). An estimate of risk was developed for Site 93, evaluating exposure to subsurface soil for future construction workers and exposure to groundwater for future adult and child residents. Additional exposure scenarios/pathways were considered but were not significant and therefore not quantitatively addressed. A detailed discussion of the exposure assessment for all scenarios considered is provided in Section 6.3 of the RI (Baker Environmental, 1998).

2.7.1.3 Toxicity Assessment

The toxicity assessment provides a numerical estimate of the relationship between the extent of exposure and possible severity of adverse effects, and consists of two steps: hazard

identification and dose-response assessment. Toxicity data used in the BRA are USEPA published toxicity values (non-carcinogenic reference doses [RfDs] and carcinogenic slope factors [CSFs]) in the Integrated Risk Information System (IRIS) and Health Effects Assessment Summary Tables (HEAST) databases. If data were not available from either of these sources, USEPA's National Center for Environmental Assessment (NCEA) data were used. Toxicity data used in risk evaluations for the COCs are provided in **Table 2-6**. A detailed discussion of the toxicity assessment is provided in Section 6.4 of the RI (Baker Environmental, 1998).

2.7.1.4 Risk Characterization

A detailed presentation of Site 93 risk characterization is provided in Section 6.5 of the RI (Baker Environmental, 1998). Risk characterization is the final step in the BRA. For carcinogens, risks are generally expressed as the incremental probability of an individual's developing cancer over a lifetime as a result of exposure to the carcinogen. Excess lifetime cancer risk is calculated using the following equation:

$$\text{Risk} = \text{CDI} \times \text{CSF}$$

where:

Risk = a unitless probability (i.e., 1×10^{-5}) of an individual's developing cancer
CDI = chronic daily intake averaged over 70 years, expressed in milligrams per kilogram per day (mg/kg-day)
CSF = carcinogenic slope factor, expressed in mg/kg-day

These risks are probabilities that usually are expressed in scientific notation (i.e., $1x10^{-6}$). An excess lifetime cancer risk of $1x10^{-6}$ indicates that an individual experiencing the reasonable maximum exposure (RME) estimate has a 1 in 1,000,000 chance of developing cancer as a result of site-related exposure. This is referred to as an "excess lifetime cancer risk" because it would be in addition to the risks of cancer individuals face from other causes such as smoking or exposure to too much sun. The chance of an individual's developing cancer from all other causes has been estimated to be as high as one in three. USEPA's generally acceptable risk range for site-related exposures is 10^{-4} to 10^{-6}.

The potential for non-carcinogenic effects is evaluated by comparing an exposure level over a specified time period (i.e., lifetime) with a RfD derived for a similar exposure period. An RfD represents a level that an individual may be exposed to that is not expected to cause any deleterious effect. The ratio of exposure to toxicity is called a hazard quotient (HQ). An HQ less than 1 indicates that a receptor's dose of a single contaminant is less than the RfD, and that toxic non-carcinogenic effects from that chemical are unlikely. The hazard index (HI) is generated by adding the HQs for all COCs that affect the same target organ (i.e., liver) or that act through the same mechanism of action within a medium or across all media to which a given individual may reasonably be exposed. An HI less than 1 indicates that, based on the sum of all HQs from different contaminants and exposure routes, toxic non-carcinogenic effects from all contaminants are unlikely. An HI greater than 1 indicates that site-related exposures may present a risk to human health. The HQ is calculated as follows:

$$\text{Non-cancer HQ} = \text{CDI}/\text{RfD}$$

CDI and RfD are expressed in the same units and represent the same exposure period (i.e., chronic, sub-chronic, or short-term).

Subsurface Soil. Risk estimates for exposure to subsurface soil are within acceptable risk levels for future construction workers. The incremental lifetime cancer risk (ICR) is 3.3×10^{-7}, which is lower than the USEPA's acceptable risk range of 10^{-6} to 10^{-4}. The noncarcinogenic HI is 0.2, which is lower than the USEPA's target HI of 1.0 for exposure. Therefore, no unacceptable risk is present.

Groundwater. Risk estimates for potable use exposure to groundwater beneath Site 93 were evaluated for child and adult residents under potential future residential use of the site (RI Appendix N, Tables 6-14 through 6-18). A summary of the site-related unacceptable human health risks from potable use exposure to Site 93 contaminated groundwater is provided in **Table 2-7**. The RME non-carcinogenic risks to an adult (HI = 2.7) and child (HI = 6.2) resident associated with ingestion of cVOC contaminated groundwater exceeded USEPA's acceptable HI of 1.0. The RME incremental lifetime cancer risk to an adult (1.2×10^{-4}) resident associated with ingestion of cVOC contaminated groundwater exceeded USEPA's acceptable cancer risk range of 10^{-6} to 10^{-4}. The cancer and non-cancer risks associated with exposure to cVOC contaminated groundwater are the basis for the remedial actions addressed in this ROD.

Summary of Total Risks Across Pathways and Media. There are no unacceptable RME risks from exposure to all media across all pathways for future construction workers (RI Appendix N, Baker Environmental, 1998). Further, there are no unacceptable RME risks from dermal absorption or inhalation exposure pathways for groundwater. Detailed risk assessment results for receptors potentially at risk from exposure across all pathways and all media are provided in the RI Appendix N (Baker Environmental, 1998) and are summarized below.

Future Resident

Potable use of groundwater would result in an RME non-cancer risk to a child (HI=6.2) and adult (HI=2.7) future resident due to cVOCs and metals in groundwater (primarily manganese and *cis*-1,2-DCE). None of the COPCs have individual non-carcinogenic hazards above 1.0.

Potable use of groundwater for lifetime exposure would result in an RME incremental cancer risk to an adult (ICR = 1.2×10^{-4}) due to cVOCs and metals in groundwater (PCE, TCE, and arsenic). None of the COPCs have individual risk levels greater than 10^{-4}. There is no unacceptable RME carcinogenic risk to a future child resident.

Uncertainty

The risk measures used in risk assessments are not fully probabilistic estimates of risk but are conditional estimates given that a set of assumptions about exposure and toxicity are realized. Thus, it is important to specify the assumptions and uncertainties inherent in the risk assessment to place the risk estimates in proper perspective. A detailed discussion of the uncertainties associated with the risk assessment is included in the RI (Baker Environmental, 1998).

2.7.2 Ecological Risk Summary

The elements of the ecological exposure assessment for OU 16 are discussed in Section 7.0 of the RI (Baker Environmental, 1998). The ERA consisted of determining whether there are ecological receptors to protect based on the ecological setting, fate and transport of the COPCs, and any potentially complete pathways. No ecological receptors were identified as being at risk for Site 93.

2.8 Remedial Action Objectives

The RAOs for the remediation of groundwater at Site 93 are based upon the potential of future residential receptors and the potential that groundwater at the site may be used for potable purposes in the future. The RAOs for Site 93 are:

1. Reduce COC concentrations in the highest concentration areas and reduce exceedances of COCs to meet the NCGWQS or maximum contaminant levels (MCLs), whichever is more conservative (see table below).
2. Prevent human exposure of water containing COCs (PCE, TCE, *cis*-1,2-DCE, *trans*-1,2-DCE, and vinyl chloride) at concentrations above NCGWQS or maximum contaminant levels (MCLs), whichever is more conservative.
3. Achieve suitability of Site 93 groundwater for unlimited use with a reasonable approach and within a reasonable timeframe.

Contaminant of Concern	Remedial Goal (µg/L)	Basis for Remedial Goal
Tetrachloroethene	0.7	NCGWQS
Trichloroethene	2.8	NCGWQS
cis-1,2-dichloroethene	70	NCGWQS
trans-1,2-dichloroethene	70	NCGWQS
Vinyl chloride	0.015	NCGWQS
1,1,2,2-tetrachloroethane	0.17	NCGWQS (Interim)

Treatment and containment technologies were evaluated to reduce and prevent migration of cVOC contaminated groundwater at Site 93. LUCs will be maintained to prevent exposure to groundwater within the boundaries of Site 93 until the concentrations of hazardous substances in the groundwater have been reduced to levels that allow for unlimited exposure and unrestricted use.

2.9 Description of Alternatives

Remedial alternatives to address cVOCs in groundwater at Site 93 were developed and are detailed in the FS. The alternatives evaluated are:

- Alternative 1 – No Action
- Alternative 2 – Permeable Reactive Barrier (PRB) Installation
- Alternative 3 – In Situ Chemical Reduction Using ZVI
- Alternative 4 – In Situ Chemical Oxidation Using Permanganate

- Alternative 5 – Air Sparging

A description of the remedy components is provided in **Table 2-8** and includes a bulleted list of the major components of each alternative identifying treatment technologies, materials, and containment components. Institutional controls, O&M, and monitoring requirements for each alternative are also presented in **Table 2-8**. The Navy, MCB Camp Lejeune, the USEPA, and NCDENR have expressed an interest in target area remediation as a means to decrease the overall contaminant mass and remediation time for the site. Further, site-wide remediation of *all* VOC impacts exceeding NCGWQS at Site 93 is not cost-effective, relative to the current low-level risk associated with the site. Accordingly, the remedial alternatives focused specifically on localized, target area remediation. Although the active alternatives employ different technologies, the expected outcomes are the same.

2.9.1 Alternative 1 – No Action

Alternative 1 is required by CERCLA to be evaluated as a baseline to compare against all other alternatives. The no action alternative does not include any institutional controls, groundwater monitoring, or active remedial activities. Further this alternative does nothing to reduce or monitor the contaminant plume in groundwater. There is no cost for this no action alternative and the timeframe is unlimited.

2.9.2 Alternative 2 – PRB Installation

Alternative 2 involves the installation of a PRB coupled with MNA. The PRB was originally intended to be installed within the target area; however, the discovery of numerous underground utilities within the source area, forced the installation of the PRB to be moved to the downgradient periphery of the Site, west of Edwards Creek, thus relying largely on natural attenuation to reduce contaminant concentrations. Because of the low hydraulic conductivity and slow process of natural attenuation at Site 93, the estimated project life is 20 years. It would take an estimated two weeks (10 days) to complete construction of Alternative 2. The components of this alternative include:

- Install a deep trench using a one-pass trencher.
- Trench is two feet in width, 500 feet in length, and 30 feet in depth.
- Backfill trench with sand and ZVI, at a ratio of approximately 20% ZVI and 80% sand.
- Long-term operation and maintenance of the PRB.
- Groundwater monitoring and reporting to assess the progress of the remedy over time.
- Statutory remedy 5-year reviews.
- LUCs will be implemented to prevent exposure to groundwater during remedy implementation.

The estimated costs for this alternative are:

- Capital Cost: $1,127,064
- Annual O&M: $326,431
- Present-Worth: $1,453,496

2.9.3 Alternative 3 – In Situ Chemical Reduction and MNA

Alternative 3 employs in situ chemical reduction with ZVI to treat the target area, and MNA of untreated areas. Two delivery methods were evaluated under this alternative: injection via the "Ferox" process and injection via geoprobe methods. The "Ferox" process involves injection of micro scale (100 to 200 micron) iron powder into pneumatic fractures, entrained by high flow nitrogen gas. Geoprobe methods involve the hydraulic injection of nano-scale (50 to 300 nanometers) ZVI slurry. The estimated timeframe for this alternative is several months within the target area and 20 years in untreated areas due to the low hydraulic conductivity and slow process of natural attenuation at Site 93. The components of this alternative include:

- Injection of ZVI into a 200 foot by 100 foot treatment area.
- 15-foot injection spacing for "Ferox" injections and 10-foot spacing for geoprobe injections.
- Eight-foot vertical injection interval (8 to 16 feet bgs).
- Target ZVI dose, based on a 0.5 percent ratio of contaminant to soil mass, is 325 pounds per injection for the "Ferox" method and 730 pounds per injection for the geoprobe injection method (total mass = 60,000 pounds for either method).
- Groundwater monitoring and reporting to assess the progress of the remedy in the treatment area and assess natural attenuation in other areas over time.
- Statutory remedy 5-year reviews.
- LUCs will be implemented to prevent exposure to groundwater during remedy implementation.

The estimated costs for this alternative using "Ferox" delivery methods are:

- Capital Cost: $859,740
- Annual O&M: $326,431
- Present-Worth: $1,186,172

The estimated costs for this alternative using geoprobe delivery methods are:

- Capital Cost: $2,307,760
- Annual O&M: $326,431
- Present-Worth: $2,634,191

2.9.4 Alternative 4 – In Situ Chemical Oxidation and MNA

Alternative 4 employs in situ chemical oxidation with permanganate to treat the target area and MNA of untreated areas. A 10-foot spacing for geoprobe injections (eight foot vertical injection interval) was conservatively estimated. A total of 200 geoprobe injection borings completed from 8 to 16 feet bgs within the target area are expected for this alternative (the same as ZVI treatment). The estimated timeframe for this alternative is several months within the target area and 20 years in untreated areas due to the low hydraulic conductivity and slow process of natural attenuation at Site 93. The components of this alternative include:

- Injection of permanganate into a 200 foot by 100 foot treatment area.
- 10-foot injection spacing and 8-foot vertical injection interval (8 to 16 feet bgs).
- Target dose of 460 pounds of potassium permanganate per injection, for a total of 92,000 pounds of potassium permanganate injected within the target area.
- Groundwater monitoring and reporting to assess the progress of the remedy in the treatment area and assess natural attenuation in other areas over time.
- Statutory remedy 5-year reviews.
- LUCs will be implemented to prevent exposure to groundwater during remedy implementation.

The estimated costs for this alternative are:

- Capital Cost: $770,622
- Annual O&M: $326,431
- Present-Worth: $1,097,054

2.9.5 Alternative 5 – Air Sparging and MNA

Alternative 5 consists of continuous air sparging of the target area for a period of two years, with MNA to address untreated areas. Two years of system operation is based on case history data and the relatively low cVOC concentrations at Site 93. However, system operation may continue for greater than two years, based on performance. The estimated timeframe for this alternative is several years within the target area and 20 years in untreated areas due to the low hydraulic conductivity and slow process of natural attenuation at Site 93. The components of this alternative include:

- Continuous air sparging into a 200 foot by 100 foot treatment area.
- 20-foot spacing between sparge wells.
- 50 one-inch diameter air sparge wells installed to a depth of approximately 30 feet bgs using a Geoprobe®.
- Conveyance piping, consisting of one-inch diameter high-density polyethylene (HDPE) buried at least two feet bgs.

- Groundwater monitoring and reporting to assess the progress of the remedy in the treatment area and assess natural attenuation in other areas over time.
- Statutory remedy 5-year reviews.
- LUCs will be implemented to prevent exposure to groundwater during remedy implementation.

The estimated costs for this alternative are:

- Capital Cost: $594,529
- Annual O&M: $566,933
- Present-Worth: $1,161,462

2.9.6 Common Elements and Distinguishing Features

The No Action alternative does not protect human health and the environment, but is presented as a baseline for comparison purposes. With the exception of the no action alternative, the common elements of the remedial alternatives evaluation are:

- Complies with ARARs
- Conducts statutory remedy 5-year reviews
- Performs groundwater monitoring and reporting
- Implements LUCs until cVOC concentrations in groundwater are reduced to levels that allow unlimited exposure and unrestricted use
- Uses the same RAOs and expected outcome of reducing cVOC concentrations to NCGWQS
- Anticipates future land use

The most distinguishing feature of the alternatives is the expected timeframe to achieve RAOs within the treatment area. Alternatives 3 and 4 have the shortest timeframe within the treatment area, although all alternatives are expected to require at least 20 years to meet RAOs in untreated areas due to the slow natural attenuation process at Site 93.

2.10 Comparative Analysis of Alternatives

Each remedial alternative for Site 93 was evaluated against the nine criteria listed below. Alternative 1 (No Action) does not achieve RAOs and is not considered further in this ROD. The Site 93 FS provides a more detailed comparative analysis of alternatives. A comparison of alternatives is presented in **Table 2-9**.

- **Protection of Human Health and the Environment**—Addresses whether each alternative provides adequate protection of human health and the environment and describes how risks posed through each exposure pathway are eliminated, reduced, or controlled, through treatment, engineering controls, and/or institutional controls.

- **Compliance with ARARs**—Section 121(d) of CERCLA and NCP §300.430(f)(1)(ii)(B) require that remedial actions at CERCLA sites at least attain legally applicable or relevant and appropriate Federal and State requirements, standards, criteria, and limitations which are collectively referred to as "ARARs," unless such ARARs are waived under CERCLA §121(d)(4).

- **Long-Term Effectiveness and Permanence**—Refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once clean-up levels have been met. This criterion includes the consideration of residual risk that will remain onsite following remediation and the adequacy and reliability of controls.

- **Reduction of Toxicity, Mobility, or Volume through Treatment**—Refers to the anticipated performance of the treatment technologies that may be included as part of a remedy.

- **Short-Term Effectiveness**—Addresses the period of time needed to implement the remedy and any adverse impacts that may be posed to workers, the community and the environment during construction and operation of the remedy until cleanup levels are achieved.

- **Implementability**—Addresses the technical and administrative feasibility of a remedy from design through construction and operation. Factors such as availability of services and materials, administrative feasibility, and coordination with other governmental entities are also considered.

- **Cost**—Refers to the estimated capital and annual operations and maintenance costs, as well as present worth cost. Present worth cost is the total cost of an alternative over time in terms of today's dollar value. Cost estimates are expected to be accurate within a range of -30 to +50 percent.

- **State Acceptance**—Considers whether the State agrees with the analyses and recommendations.

- **Community Acceptance**—Considers whether the local community agrees with the analyses and preferred alternative.

2.10.1 Threshold Criteria

2.10.1.1 Protection of Human Health and the Environment

With the exception of No Action, the LUC and MNA components of all the alternatives provides protection of human health and the environment until such time as the remedy reduces cVOCs to acceptable risk levels. The balance of trade-offs is the degree of treatment verses containment and the duration that LUCs and MNA must be maintained to ensure protection. The greatest protection occurs with Alternatives 3, 4, and 5 where treatment is the principal component and requires the shortest timeframe for achieving RAOs within the treatment area. Alternative 2 relies on the natural movement of groundwater, so the time frame for achieving RAOs within the treatment area is expected to be long.

2.10.1.2 Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)

All alternatives meet ARARs. As with protection of human health and the environment, the balance of trade-offs is the preference for treatment over containment when considered against the timeframe estimated to achieve RAOs. Consequently, Alternatives 3, 4, and 5 are ranked higher for compliance with ARARs as they are expected to achieve RAOs within the treatment area in the shortest timeframe.

2.10.2 Primary Balancing Criteria

2.10.2.1 Long-Term Effectiveness and Permanence

While all of the alternatives are expected to eventually meet the criteria for long-term effectiveness and permanence, the alternatives with active treatment components designed to permanently reduce cVOCs to acceptable risk levels have the greatest impact on long-term effectiveness and permanence. Because treatment under Alternatives 3, 4, and 5 are expected to permanently achieve RAOs within the treatment area in the shortest timeframes, these alternatives are valued over the other alternatives for this criterion. However, "rebound" is a potential issue with any injection scenario (Alternatives 3 or 4) or even air sparging (Alternative 5).

2.10.2.2 Reduction in Toxicity, Mobility, or Volume

While all of the alternatives are expected to eventually reduce toxicity, mobility, or volume, alternatives with active treatment components designed to reduce cVOCs to acceptable risk levels have the greatest impact on reducing toxicity or volume. Containment components such as reactive barriers have the greatest impact on mobility. Alternatives 3, 4 and 5 are expected to reduce cVOC levels within the treatment area very quickly thus reducing toxicity and volume; whereas under Alternative 2, toxicity, mobility, and volume are expected to be largely unaffected until the groundwater plume reaches the PRB.

2.10.2.3 Short-Term Effectiveness

Short-term effectiveness was evaluated with respect to the adverse effects the remedy may pose to the community, workers, and the environment during implementation as well as with respect to the time required to achieve RAOs. Alternatives 2 and 3 have negligible short-term risks, while short-term risks are minimized for Alternatives 4 and 5 through the use of appropriate personal protective equipment and air monitoring. Short-term effectiveness in terms of the time required to achieve RAOs will favor source area treatments (Alternatives 3, 4, and 5); while Alternative 2 is expected to require 20 years or more to achieve RAOs.

2.10.2.4 Implementability

This criterion was evaluated with respect to ease of implementing the remedy in terms of construction and operation, and the availability of services and materials required to implement the alternative. With respect to construction, Alternative 2 is considered to be the easiest to implement. However, alternatives with long-term O&M components (i.e., Alternatives 2 and 5) increase the difficulty of implementation as these components must be inspected, monitored, and repaired over the years the remedy is in place before achieving RAOs. While in-situ chemical injection alternatives (Alternatives 3 and 4) are moderately

difficult to implement in the short-term, the fact that RAOs are achievable in much shorter time frames increases ease of implementation over the life of the remedy.

2.10.2.5 Cost

The greatest factor affecting the total implementation cost is the projected capital cost. The highest capital cost is for in situ chemical reduction via ZVI injection using a Geoprobe®, followed by the capital cost for construction of a PRB. The cost of materials is largely responsible for the increased capital cost of ZVI injection using a Geoprobe® over ZVI injection via the "Ferox" process, due to the larger number of injection points (200 versus 90). O&M costs for Alternatives 2, 3, and 4 are similar due to long-term monitoring costs required for 20 years or more. O&M costs for Alternative 5 are higher because, unlike other source zone treatments, the air sparge system is expected to operate continuously for two years, thus incurring weekly maintenance costs. Alternative 4 is the most cost-effective alternative.

2.10.3 Modifying Criteria

2.10.3.1 State Acceptance

State involvement has been solicited throughout the CERCLA process and proposed remedy selection. NCDENR, as the designated State support agency in North Carolina, has reviewed this ROD and has given concurrence on the Selected Remedy.

2.10.3.2 Community Acceptance

The public meeting was held on February 16, 2006 to present the PRAP and answer community questions regarding the proposed remedial action at Site 93. There were no concerns raised at the meeting, and the questions were general inquiries for information purposes only. No significant comments were received from the public. Detailed information on the public meeting is provided in the Responsiveness Summary of this ROD.

2.11 Principal Threat Wastes

The NCP establishes an expectation that the USEPA will use treatment to address the principal threats posed by a site whenever practicable. Principal threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be contained in a reliable manner or would present a significant risk to human health or the environment should exposure occur.

Under current land use, groundwater is not used as a potable supply. For anticipated future land use scenarios LUCs will prohibit potable groundwater use until concentrations are reduced to levels that allow for unlimited exposure and unrestricted use. Therefore, there are no realistic exposure scenarios. All available data suggest that mobility and migration of contaminated groundwater is limited at Site 93, therefore, no principle threat waste has been identified.

2.12 Selected Remedy

Alternative 4, in situ chemical oxidation via permanganate injection and MNA, is the Selected Remedy to address groundwater contamination at Site 93.

2.12.1 Summary of Rationale for the Selected Remedy

Alternative 4 is expected to achieve substantial risk reduction and RAOs within the treatment area within the shortest timeframe. Alternative 4 is also expected to reduce cVOC concentrations in groundwater to the maximum extent practicable for the remedial technologies available. Further, a pilot study involving permanganate injection to treat cVOCs was recently completed at another site at MCB Camp Lejeune with favorable results.

Based on information currently available, the Navy, MCB Camp Lejeune, USEPA, and NCDENR believe in situ chemical oxidation via permanganate injection meets the threshold criteria and provides the best balance of tradeoffs among the other alternatives with respect to the balancing and modifying criteria. The Selected Remedy is anticipated to satisfy the following requirements of CERCLA: (1) protective of human health and the environment, (2) comply with ARARs, (3) cost-effective, (4) utilize permanent solutions and alternative treatment technologies to the maximum extent practicable, and (5) satisfy the preference for treatment as a principal element.

2.12.2 Description of the Selected Remedy

The Selected Remedy includes injection of permanganate to treat a 200 foot by 100 foot target area and MNA for untreated areas. LUCs for groundwater shall be maintained for as long as required to prevent unacceptable exposures to contaminated groundwater or to preserve the integrity of the remedy.

Prior to treatment, a baseline round of groundwater samples will be collected from existing monitoring wells at Site 93, and will be used to supplement existing data to confirm treatment area location and injection mass. Monitoring wells will be sampled for Target Compound List (TCL) VOCs and NAIP. After analysis of the baseline groundwater samples, additional monitoring wells will be installed at Site 93 if necessary to further monitor the cVOC plume in groundwater.

Chemical injection of permanganate is the selected groundwater treatment technology within the 200 foot by 100 foot target treatment area at Site 93. The proposed chemical oxidation treatment includes the injection of a chemical such as potassium permanganate into 200 geoprobe borings within the target area. The oxidizing agent will be pushed into the groundwater table with potable water to distribute the chemicals. This process requires an estimated 460 pounds of potassium permanganate per injection boring, for a total of 92,000 pounds of potassium permanganate injected into the treatment area. The conceptual layout of permanganate injections is shown in **Figure 2-8**. The projected timeframe for completing the injection is 30 to 35 working days (using two injection rigs) or 50 to 55 days (using one rig), depending on conditions encountered in the field.

The Navy, MCB Camp Lejeune, USEPA, and NCDENR agreed that the injection of the permanganate will be a "one-time" approach (assuming residual impacts will be addressed by MNA). Groundwater monitoring will be conducted upon completion of the target area

treatment on a quarterly basis for the first year and then on an annual basis thereafter. Samples collected from the monitoring wells will be analyzed for VOCs and NAIP. The duration of monitoring will be assessed during the 5-year remedy reviews.

Throughout implementation of the remedy, the Navy will utilize LUCs to prevent potential unacceptable risks to human receptors from exposure to contaminants in groundwater. LUCs will be implemented and maintained by the Navy within the boundaries of Site 93 until the concentrations of hazardous substances in the groundwater have been reduced to levels that allow for unlimited exposure and unrestricted use. The LUCs will meet the following objectives:

- Prohibit the withdrawal of groundwater except for environmental monitoring from the aquifers (surficial and Castle Hayne) within 1,000 feet of the groundwater plume (**Figure 2-9**), and
- Prohibit intrusive activities within the extent of the current groundwater contamination unless specifically approved by both NCDENR and USEPA until RAOs are achieved.
- Maintain the integrity of any current or future remedial or monitoring system such as monitoring wells.
- Specific types of LUCs to be employed for these purposes will include: 1) incorporating land use prohibitions into the MCB Camp Lejeune Base Master Plan; 2) a deed Notice of Inactive Hazardous Substance or Waste Disposal filed in Onslow County real property records per North Carolina General Statutes (NCGS) 130A-310.8; and 3) deed restrictions included in any deed transferring any portion of Site 93 to any non-Federal transferee.

The Navy shall develop and submit to USEPA and NCDENR, in accordance with the FFA and the schedule in the SMP, a groundwater treatment Remedial Action Work Plan and a LUC RD. The LUC RD will provide for implementation and maintenance actions, including periodic inspections and reporting. The Navy will implement, maintain, monitor, report on and enforce the LUCs according to the RD.

2.12.3 Summary of the Estimated Remedy Costs

The estimates costs for Alternative 4, in situ chemical oxidation via permanganate injection and MNA, are summarized in **Table 2-8** and detailed in **Table 2-10.** The information in this cost estimate is based on the best available information regarding the anticipated scope of the Selected Remedy. Changes in the cost estimate may occur as a result of new information and data collected during the development of the remedial design of the Selected Remedy. Major changes will be documented in the form of a memorandum in the Administrative Record file. This is an order-of-magnitude engineering cost estimate that is expected to be within +50 percent to -30 percent of the actual costs. A complete cost summary for each remedial alternative is provided in Appendix B of the Final Site 93 FS (CH2M HILL, November 2005).

2.12.4 Expected Outcomes of the Selected Remedy

Current land uses are expected to continue at Site 93 and there is no other planned land use in the foreseeable future. If Alternative 4 is implemented, exposure will be controlled through LUCs until groundwater cVOC concentrations are reduced to acceptable levels for unlimited exposure and unrestricted use. The effectiveness of treatment of cVOCs in groundwater will be measured by comparison to NCGWQS. In accordance with the LUC objectives, groundwater use will be restricted to monitoring or remedial purposes. Groundwater quality will be assessed through monitoring to provide evidence that attenuation is occurring. When a single COC is at or below its respective remediation goal for four consecutive sampling events, this COC will no longer require monitoring, while the other will continue to be analyzed and documented in annual technical memoranda. When all COCs have achieved their goals for four consecutive sampling events, procedures for site closure will be initiated. Once RAOs for this groundwater action have been achieved, the Site 93 area is expected to be suitable for unlimited use and unrestricted exposure. Therefore, the Navy, USEPA, and NCDENR may agree for the LUC component of the Selected Remedy to be terminated at site closeout. NCGWQS for the COCs at Site 93 are:

- Tetrachloroethene - 0.7 µg/L
- Trichloroethene - 2.8 µg/L
- *cis*- and *trans*-1,2-DCE - 70 µg/L
- Vinyl chloride - 0.015 µg/L
- 1,1,2,2-Tetrachloroethane - 0.17 µg/L (Interim Maximum Allowable Concentration)

2.13 Statutory Determinations

Remedial actions undertaken at NPL sites must meet the statutory requirements of Section 121 of CERCLA and thereby achieve adequate protection of human health and the environment, comply with ARARs of both federal and state laws and regulations, be cost-effective, and use, to the maximum extent practicable, permanent solutions and alternative treatment or resource recovery technologies. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduces the volume, toxicity, and/or mobility of hazardous waste as the principal element. The following discussion summarizes the statutory requirements that are met by the Selected Remedy.

2.13.1 Protection of Human Health and the Environment

The Selected Remedy, Alternative 4, will protect human health and the environment by reducing and controlling site risks through groundwater treatment to reduce contaminant mass and toxicity and the implementation of LUCs to eliminate the threat of exposure to the COCs via direct contact with or ingestion of impacted groundwater. Implementation of the selected remedy will not pose unacceptable short-term risks or cross-media impacts.

2.13.2 Compliance with Applicable or Relevant and Appropriate Requirements and To-Be-Considered Criteria

The Selected Remedy, Alternative 4, will meet all identified ARARs. Federal and state ARARs, summarized by classification, for Site 93 are presented in **Appendix B**. In addition,

other to-be-considered (TBC) criteria are included as appropriate for each classification. The classifications of ARARs identified include chemical-specific, location-specific, and action-specific.

The RAO is to reduce cVOC concentrations in groundwater to NCGWQS or MCLs, whichever is more conservative. Site 93 LUCs will be maintained until groundwater concentrations reach levels that allow for unlimited exposure and unrestricted use. If the remedy goals are not met, additional remedial action treatment technologies may be implemented in the future.

2.13.3 Cost-Effectiveness

The Selected Remedy, Alternative 4, is cost-effective and represents a reasonable value for the money to be spent. In making this determination, the following definition was used: "A remedy shall be cost-effective if its costs are proportional to its overall effectiveness (NCP §300.430(f)(1)(ii)(D))". This was accomplished by evaluating the overall effectiveness of those alternatives that satisfied the threshold criteria. Overall effectiveness was then compared to costs to determine cost-effectiveness. The relationship of the overall effectiveness of this remedial alternative was determined to represent a reasonable value for the money to be spent.

The estimated present-worth cost of the Selected Remedy is $1,097,000. The Selected Remedy is cost-effective because it provides protection of human health and the environment in the shortest timeframe minimizing long term operation, maintenance, and monitoring costs.

2.13.4 Utilization of Permanent Solutions and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Practicable

The Navy, MCB Camp Lejeune, USEPA, and the State of North Carolina determined that the Selected Remedy, Alternative 4, represents the maximum extent to which permanent solutions and treatment technologies can be used in a practicable manner at Site 93. The selected remedy utilizes treatment through chemical injection to induce de-chlorination and reduce contaminant mass. Because long-term effectiveness and permanence along with reduced toxicity and volume are achieved in the shortest timeframe with the selected remedy, the Navy, MCB Camp Lejeune, USEPA, and the State of North Carolina determined that the Selected Remedy provides the best balance of tradeoffs in terms of the balancing criteria, while also considering the statutory preference for treatment as a principal element and considering state and community acceptance.

2.13.5 Preference for Treatment as a Principal Element

The Selected Remedy uses treatment as a principal element, and therefore satisfies the statutory preference for treatment.

2.13.6 Five-Year Review Requirements

Until this remedy reduces cVOC concentrations on site below levels that allow for unlimited exposure and unrestricted use, the Navy will maintain LUCs along with the MNA remedy

and conduct a statutory remedy review every five years after initiating remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

2.14 Documentation of Significant Changes

The PRAP for Site 93 was released for public comment on February 16, 2006. The PRAP identified Alternative 4, in situ chemical oxidation via permanganate injection and MNA, as the Preferred Alternative for groundwater remediation. The Navy reviewed all comments submitted during the public comment period. It was determined that no significant changes to the remedy, as originally identified in the PRAP, were necessary or appropriate.

SECTION 3

Responsiveness Summary

In accordance with Section 113 and 117 of CERCLA, the Navy provided a public comment period from February 16 through March 16, 2006, for the proposed remedial action described in the FS and PRAP for Site 93. A public meeting to present the PRAP was held at the Coastal Carolina Community College, located in Jacksonville, North Carolina on February 16, 2006. Public notice of the meeting and availability of documents was placed in *The Jacksonville Daily News* and *The Globe* newspapers on February 1, 2006 and February 2, 2006, respectively.

The participants in the Public Meeting held on February 16, 2006, included representatives of the Navy, MCB Camp Lejeune, USEPA, and NCDENR. Six community members attended the meeting. Question received during the public meeting were general inquiries and are described in PRAP Public Meeting minutes in **Appendix C**. There were no significant comments received at the public meeting requiring amendment to the PRAP, and no additional written comments, concerns, or questions were received from community members during the public comment period.

SECTION 4

References

Baker Environmental, 1998. *Final Remedial Investigation of Operable Unit 16 (Sites 89 and 93),* Marine Corps Base Camp Lejeune, Jacksonville, North Carolina, June 1998.

Baker Environmental, 2002. *Site 93 Additional Plume Characterization Letter Report for Site 93,* Marine Corps Base Camp Lejeune, Jacksonville, North Carolina, March 2002.

Baker Environmental, 2005. *Final Fiscal Year 2005 Site Management Plan,* Marine Corps Base Camp Lejeune, Jacksonville, North Carolina, March 2005.

CH2M HILL, 2005. *Final Site 93 Feasibility Study,* Marine Corps Base Camp Lejeune, Jacksonville, North Carolina, November 2005.

CH2M HILL, 2006. *Proposed Remedial Action Plan, Site 93, Operable Unit No. 16,* Marine Corps Base Camp Lejeune, Jacksonville, North Carolina, January 2006.

USEPA, July 1999. *A Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents.* USEPA 540-R-98-031, OSWER 9200.1-23P, PB98-963241.

Tables

TABLE 2-1
Phase I and Phase II RI Sample Summary
Site 93 Record of Decision
MCB Camp Lejeune

Sample Matrix	Collection Technique	Approximate Sample Depth [2] (feet bgs)	Analyte [1]									
			TCL VOCs	TCL SVOCs	TCL Pesticides/ PCBs	TAL Metals	Natural [3] Attenuation Parameters	BOD/ COD	Methane	Total Organic Carbon	Bulk Density	Grain Size
Phase I Sample Summary:												
Groundwater	Peristaltic pump	NA	15	--	--	--	--	--	--	--	--	--
Phase II Sample Summary:												
Soil	Split spoon sampler	3-5', 7-9', 13-15'	22	22	4	22	--	--	--	1	1	1
Groundwater	Peristaltic pump	NA	11	11	2	11	5	4	5	--	--	--

Notes:

(1) "—" Parameter not analyzed

(2) Approximate sample depth 'NA' – Not Applicable

(3) Natural attenuation parameters include nitrate, nitrite, sulfate, chloride, ferrous iron, and sulfide

bgs – below ground surface
TCL – Target Compound List
VOC – Volatile Organic Compound
SVOC – Semi-volatile Organic Compound
PCB – Polychlorinated Biphenyl
TAL – Target Analyte List
BOD – Biochemical Oxygen Demand
COD – Chemical Oxygen Demand

TABLE 2-2
Additional Plume Characterization Sample Summary
Site 93 Record of Decision
MCB Camp Lejeune

Sample Matrix	Collection Technique	Approximate Sample Depth [2] (feet bgs)	Analyte [1]		
			TCL VOCs	TAL Metals	Total Organic Carbon
Groundwater (Direct Push)	Peristaltic pump	5-9', 15-19', 25-29', and 35-39'	44	--	--
Groundwater (Monitoring Well)	Peristaltic pump	NA	--	1	--
Soil	Split spoon sampler	5', 10'	--	--	2

Notes:

(1) "—" Parameter not analyzed
(2) Approximate sample depth 'NA' – Not Applicable

bgs – below ground surface
TCL – Target Compound List
VOC – Volatile Organic Compound
TAL – Target Analyte List

TABLE 2-3
Supplemental Site Investigation Sample Summary
Site 93 Record of Decision
MCB Camp Lejeune

Sample Matrix	Collection Technique	Approximate Sample Depth [2] (feet bgs)	Analyte [1]			
			TCL VOCs	Iron	Manganese	Natural Attenuation Parameters [3]
Groundwater (Direct Push)	Peristaltic pump	6-16', 14-30', and 25-38'	16	--	--	--
Groundwater (Monitoring Well)	Peristaltic pump	NA	13	13	13	13

Notes:

(1) "—" Parameter not analyzed

(2) Approximate sample depth 'NA' – Not Applicable

(3) Natural attenuation parameters include chloride, ethene, ethane, methane, nitrate, nitrite, sulfate, sulfide, total dissolved solids, total suspended solids

bgs – below ground surface
TCL – Target Compound List
VOC – Volatile Organic Compound

TABLE 2-4
Groundwater Chemicals of Concern
Site 93 Record of Decision
MCB Camp Lejeune

Chemical	Minimum [1] Concentration (µg/L)	Maximum [1] Concentration (µg/L)	Location of Maximum Concentration	Detection Frequency	Concentration Used for Screening (µg/L)	Screening [2] Toxicity Value (µg/L)		Potential ARAR/ TBC Value (µg/L)	Potential ARAR/ TBC Source	COPC Flag	Rationale for [3] Contaminant Deletion or Selection
Volatile Organic Compounds											
cis-1,2-Dichlorethene	4	175	TW01	3/15	175	6.1	N	70	NCWQS	Yes	ASL
trans-1,2-Dichloroethene	5	57	TW01	2/15	57	12	N	70	NCWQS	Yes	ASL
1,2-Dichloroethene (total)	92	92	MW05	1/11	92	5.5	N	70	NCWQS	Yes	ASL
Tetrachloroethene	0.1	65.1	MW05	7/26	65.1	1.1	C	0.7	NCWQS	Yes	ASL
Trichloroethene	0.1	39.4	TW01	8/26	39.4	1.6	C	2.8	NCWQS	Yes	ASL
Metals											
Antimony	2.3	2.3	MW02-IW	1/11	2.3	1.5	N	6	MCL	Yes	ASL
Arsenic	4.3	4.3	MW02-IW	1/11	4.3	0.045	C	50	NCWQS	Yes	ASL
Iron	577	4,330	MW01-IW	11/11	4,330	1,100	N	300	NCWQS	Yes	ASL
Lead	164	164	MW02-IW	1/11	164	NE		15	NCWQS	Yes	ASL
Manganese	9.2	432	MW01	11/11	432	73	N	50	NCWQS	Yes	ASL

(1) Minimum and maximum detected concentration

(2) Tier I screening: With the exception of lead, all compounds are screened against the Risk Based Concentration (RBC) Table, U.S. EPA Region III, April 15, 1998 for tap water (cancer benchmark value = $1x10^{-6}$, HQ = 0.1). Lead is screened against the NCWQS value of 15 µg/L.

(3) Rationale Codes:
Selection Reason: Above Screening Level (ASL)
No Toxicity Information (NTX)
Deletion Reason: Below Screening Level (BSL)

Definitions:
ARAR – Applicable or Relevant and Appropriate Requirement
COPC – Contaminant of Potential Concern
NCWQS – North Carolina Water Quality Standards for Groundwater
MCL – Federal Maximum Contaminant Level

C – Carcinogenic
N – Non-carcinogenic
NE – Not Established

µg/L – micrograms per liter

TABLE 2-5
Exposure Point Concentration Summary for Groundwater
Site 93 Record of Decision
MCB Camp Lejeune

Contaminant of Potential Concern	Arithmetic Mean (µg/L)	95% UCL of Normal Data (µg/L)	Maximum Detected Concentration (µg/L)	Reasonable Maximum Exposure			Central Tendency		
				Medium EPC Value (µg/L)	Medium [1] EPC Statistic	Medium EPC Rationale	Medium EPC Value (µg/L)	Medium [1] EPC Statistic	Medium EPC Rationale
Volatile Organic Compounds									
cis-1,2-Dichlorethene	13.33	33.74	175	175	Max	W-Test [2]	30.42	95% UCL-T	W-Test [3]
trans-1,2-Dichloroethene	4.57	11.19	57	57	Max	W-Test [2]	6.86	95% UCL-T	W-Test [3]
1,2-Dichloroethene (total)	12.91	27.24	92	92	Max	W-Test [2]	20.89	95% UCL-T	W-Test [3]
Tetrachloroethene	5.58	9.83	65.1	65.1	Max	W-Test [2]	5.58	Mean-N	W-Test [4]
Trichloroethene	5.55	8.82	39.4	39.4	Max	W-Test [2]	39.4	Max	W-Test [2]
Metals									
Antimony	1.07	1.29	2.3	2.3	Max	W-Test [2]	1.26	95% UCL-T	W-Test [3]
Arsenic	1.62	2.11	4.3	4.3	Max	W-Test [2]	2.01	95% UCL-T	W-Test [3]
Iron	2434.64	3119.36	4,330	4,330	Max	W-Test [2]	4222.28	95% UCL-T	W-Test [3]
Lead	15.55	42.46	164	164	Max	W-Test [2]	49.14	95% UCL-T	W-Test [3]
Manganese	84.45	153.88	432	432	Max	W-Test [2]	256.4	95% UCL-T	W-Test [3]

(1) Statistics: Maximum detected value (Max); 95% UCL of normal data (95% UCL-N); 95% UCL of log-transformed data (95% UCL-T); mean of normal data (Mean-N); mean of log-transformed data (Mean-T).

(2) 95% UCL exceeds maximum detected concentration. Therefore, maximum concentration used for EPC.

(3) Shapiro-Wilk W Test indicates data are lognormally distributed.

(4) Shapiro-Wilk W Test inconclusive. Higher of mean value for normally and lognormally distributed data used for CT EPC.

Definitions:
CT – Central Tendency
EPC – Exposure Point Concentration
RME – Reasonable Maximum Exposure
UCL – Upper Confidence Limit

µg/L – micrograms per liter

TABLE 2-6
Cancer and Non-Cancer Toxicity Data
Site 93 Record of Decision
MCB Camp Lejeune

Contaminant of Potential Concern	Oral RfD Value (mg/kg-day)	Oral [1] Absorption Factors	Adjusted [2] Dermal RfD Value (mg/kg-day)	Inhalation RfD (mg/kg-day)	Oral CSF $(mg/kg\text{-}day)^{-1}$	Adjusted [2] Dermal CSF $(mg/kg\text{-}day)^{-1}$	Inhalation CSF $(mg/kg\text{-}day)^{-1}$	Weight [3] of Evidence	Reference
Volatile Organic Compounds									
cis-1,2-Dichlorethene	1.0E-02	80%	8.0E-03	NE	NE	NE	NE	D	HEAST
trans-1,2-Dichloroethene	2.0E-02	80%	1.6E-02	NE	NE	NE	NE	D	IRIS
1,2-Dichloroethene (total)	9.0E-03	80%	7.2E-03	NE	NE	NE	NE	C	HEAST
Tetrachloroethene	1.0E-02	80%	8.0E-03	NE	5.2E-02	6.5E-02	2.0E-03	--	IRIS, EPA-NCEA
Trichloroethene	6.0E-03	80%	4.8E-03	NE	1.1E-02	1.4E-02	6.0E-03	B2	EPA-NCEA
Metals									
Antimony	4.0E-04	20%	8.0E-05	NE	NE	NE	NE	D	IRIS
Arsenic	3.0E-04	20%	6.0E-05	NE	1.5	7.5	15.1	A	IRIS
Iron	3.0E-01	20%	6.0E-02	NE	NE	NE	NE	ND	EPA-NCEA
Manganese	2.3E-02	20%	4.6E-03	1.43E-05	NE	NE	NE	D	IRIS

(1) EPA Region IV recommended values.

(2) Only oral toxicity values were dermally adjusted; inhalation toxicity values were not adjusted.
Adjusted RfD = oral RfD * oral absorption factor
Adjusted CSF = oral CSF/oral absorption factor

(3) EPA Group:
A – Human Carcinogen
B2 – Probable Human Carcinogen – sufficient evidence
C - Possible Human Carcinogen
D – Not Classifiable as a Human Carcinogen

Definitions:
CSF – Cancer Slope Factor
EPA – Environmental Protection Agency
HEAST – Health Effects Assessment Summary Tables
IRIS – Integrated Risk Information System
NCEA – National Center for Environmental Assessment
NE – Not Established
RfD – Non-carcinogenic Reference Dose

mg/kg-day – milligrams per kilogram per day

TABLE 2-7
Potable Use Groundwater Human Health Risk Summary
Site 93 Record of Decision
MCB Camp Lejeune

Receptor	Pathway	Contaminant of Potential Concern	RME Incremental Lifetime Cancer Risk	RME Non-Cancer Hazard Index
Future Adult Resident	Ingestion	*cis*-1,2-Dichlorethene	NA	4.8E-01
		trans-1,2-Dichloroethene	NA	7.8E-02
		1,2-Dichloroethene (total)	NA	2.8E-01
		Tetrachloroethene	4.0E-05	1.8E-01
		Trichloroethene	5.1E-06	1.8E-01
		Antimony	NA	1.6E-01
		Arsenic	7.6E-05	3.9E-01
		Iron	NA	4.0E-01
		Lead	NA	NA
		Manganese	NA	5.1E-01
		TOTAL RISK ACROSS PATHWAY:	**1.2E-04**	**2.7**
	Dermal Absorption	*cis*-1,2-Dichlorethene	NA	1.7E-02
		trans-1,2-Dichloroethene	NA	2.8E-03
		1,2-Dichloroethene (total)	NA	1.0E-02
		Tetrachloroethene	6.9E-06	3.1E-02
		Trichloroethene	2.9E-07	1.0E-02
		Antimony	NA	2.3E-03
		Arsenic	1.1E-06	5.6E-03
		Iron	NA	5.7E-03
		Lead	NA	NA
		Manganese	NA	7.4E-03
		TOTAL RISK ACROSS PATHWAY:	**8.2E-06**	**0.1**
	Inhalation	*cis*-1,2-Dichlorethene	NA	NA
		trans-1,2-Dichloroethene	NA	NA
		1,2-Dichloroethene (total)	NA	NA
		Tetrachloroethene	1.2E-07	NA
		Trichloroethene	2.3E-07	NA
		TOTAL RISK ACROSS PATHWAY:	**3.5E-07**	NA
TOTAL RISK ACROSS ALL EXPOSURE ROUTES:			**1.3E-04**	**2.8**

TABLE 2-8
Description of Remedial Alternatives for Site 93
Site 93 Record of Decision
MCB Camp Lejeune

Alternative	Components	Details	Cost	
1– No Action	Existing groundwater plume.	Not Applicable.	Capital Cost	$0
			Annual O&M	$0
			Present-Worth	$0
			Time Frame:	>20 years
2– Permeable Reactive Barrier Installation and MNA	– Downgradient permeable ZVI & sand reactive barrier. – MNA – LUCs	– Installation of a downgradient ZVI PRB: – Installed using a one-pass trencher – Trench is 2 ft wide, 500 ft long, and 30 ft in depth. – Long-term operation and maintenance of PRB (>20 years). – Groundwater monitoring and reporting to assess the progress of remedy over time. – Statutory remedy 5-year reviews.	Capital Cost	$1,127,064
			Annual O&M	$326,431
			Present-Worth	$1,453,496
			Time Frame:	>20 years
3– In Situ Chemical Reduction and MNA	– Injection of ZVI slurry into the treatment area to enhance chemical reduction. – MNA of untreated areas – LUCs	– Injection of ZVI slurry into the treatment area via "Ferox" (pneumatic fracturing) process or geoprobe: – 200 ft by 100 ft treatment area. – 15-ft injection spacing for "Ferox", 10-ft injection spacing for geoprobe. – 8-ft vertical injection interval (8-16 ft bgs) – 60,000 pounds of ZVI. – Groundwater monitoring and reporting to assess the progress of remedy in treatment area and assess natural attenuation in other areas over time. – Statutory remedy 5-year reviews.	<u>ZVI Injection via "Ferox"</u>	
			Capital Cost	$859,740
			Annual O&M	$326,431
			Present-Worth	$1,186,172
			<u>ZVI Injection via Geoprobe</u>	
			Capital Cost	$2,307,760
			Annual O&M	$326,431
			Present-Worth	$2,634,191
			Time Frame: Several months in treatment area, >20 years in other areas (due to MNA)	

TABLE 2-8
Description of Remedial Alternatives for Site 93
Site 93 Record of Decision
MCB Camp Lejeune

Alternative	Components	Details	Cost
4– In Situ Chemical Oxidation and MNA	– Injection of permanganate into the treatment area to enhance chemical oxidation. – MNA of untreated areas – LUCs	– Injection of permanganate into the treatment area: – 200 ft by 100 ft treatment area. – 10-ft injection spacing, 8-ft vertical injection interval (8-16 ft bgs). – 92,000 pounds of potassium permanganate. – Groundwater monitoring and reporting to assess the progress of remedy in treatment area and assess natural attenuation in other areas over time. – Statutory remedy 5-year reviews.	Capital Cost $770,622 Annual O&M $326,431 Present-Worth $1,097,054 Time Frame: Several months in treatment area, >20 years in other areas (due to MNA)
5– Air Sparging and MNA	– Continuous air sparging in the treatment area. – MNA of untreated areas – LUCs	– Continuous air sparging into the treatment area: – 200 ft by 100 ft treatment area. – 20-ft spacing between sparge wells. – 50 1-inch diameter sparge wells installed to a depth of 30 feet bgs. – Long-term operation and maintenance of air sparge system (2 years). – Groundwater monitoring and reporting to assess the progress of remedy in treatment area and assess natural attenuation in other areas over time. – Statutory remedy 5-year reviews.	Capital Cost $594,529 Annual O&M $566,933 Present-Worth $1,161,462 Time Frame: Several years in treatment area, >20 years in other areas (due to MNA)

TABLE 2-9
Relative Ranking of Remedial Alternatives
Site 93 Record of Decision
MCB Camp Lejeune

	Alternative					
CERCLA Criteria	**No Action** (1)	**Permeable Reactive Barrier** (2)	**In Situ Chemical Reduction (ZVI) via "Ferox"** (3a)	**In Situ Chemical Reduction (ZVI) via Geoprobe®** (3b)	**In Situ Chemical Oxidation (Permanganate)** (4)	**Air Sparging** (5)
Threshold Criteria						
Protection of Human Health and the Environment	○	◎	●	●	●	●
Compliance with ARARs	○	◎	●	●	●	●
Primary Balancing Criteria						
Long-term Effectiveness and Permanence	○	○	●	●	●	◎
Reduction in Toxicity, Mobility, or Volume	○	○	●	●	●	◎
Short-Term Effectiveness	○	◎	●	●	◎	◎
Implementability	●	●	◎	◎	◎	◎
Total Implementation Cost	●	◎	◎	○	◎	◎

Ranking: ● High ◎ Moderate ○ Low

Rankings are provided as qualitative descriptions of the relative compliance of each alternative with the criteria

TABLE 2-10

Cost Summary for Alternative 4 - In Situ Chemical Oxidation via Potassium Permanganate Injection and MNA

Site 93 Record of Decision

MCB Camp Lejeune

Description	Estimated Quantity	Unit	Unit Cost	Total Cost
CAPITAL COSTS				
PRE-CONSTRUCTION ACTIVITY				
Site Prep and Initial Survey	1	LS	$ 7,500	$ 7,500
Work Plan and Submittals	1	LS	$ 12,000	$ 12,000
SYSTEM INSTALLATION				
Materials: ZVI, 200 Injection Borings, 10 Foot Spacing	92,000	lbs	$ 2	$ 184,000
Materials Shipping/Handling (KMnO4)	1	LS	$ 5,000	$ 5,000
Temporary Materials Storage On-Site	55	days	$ 250	$ 13,750
Injection Labor, Equipment, Perdiem	1	LS	$ 241,397	$ 241,397
Subcontractor Injection Summary Report	1	LS	$ 7,500	$ 7,500
SITE RESTORATION				
Site Restoration	1	LS	$ 7,500	$ 7,500
Subtotal				**$ 478,647**
Project Management			8%	$ 38,292
Remedial Design			5%	$ 23,932
Construction Management and Procurement			15%	$ 71,797
Overhead			8%	$ 38,292
Profit			10%	$ 47,865
Contingency			15%	$ 71,797
TOTAL CAPITAL COST				**$ 770,622**
OPERATIONS & MAINTENANCE COSTS (Year 1)				
GROUNDWATER SAMPLING (Quarterly)				
Sample Labor	4	events	$ 3,000	$ 12,000
Sample Analysis - Subcontractor	64	sample	$ 360	$ 23,040
GW Sampling Equipment Rental/Supplies	4	round	$ 1,000	$ 4,000
SUBTOTAL				$ 39,040
REPORTING (4 Quarterly Reports & Detailed MNAStudy)				
Reporting Labor (quarterly reports)	4	report	$ 5,000	$ 20,000
Reporting Labor (detailed MNA study)	1	report	$ 14,000	$ 14,000
SUBTOTAL				$ 34,000
SUBTOTAL				$ 73,040
CONTINGENCY			15%	$ 10,956
TOTAL ANNUAL O&M COSTS (Year 1)				**$ 83,996**

LS - Lump Sum
lbs - pounds

TABLE 2-10

Cost Summary for Alternative 4 - In Situ Chemical Oxidation via Potassium Permanganate Injection and MNA
Site 93 Record of Decision
MCB Camp Lejeune

Description	Estimated Quantity	Unit	Unit Cost	Total Cost
OPERATIONS & MAINTENANCE COSTS (Years 2-20)				
GROUNDWATER SAMPLING (Annual)				
Sample Labor	1	event	$ 3,000	$ 3,000
Sample Analysis - Subcontractor	16	sample	$ 360	$ 5,760
GW Sampling Equipment Rental/Supplies	1	round	$ 1,000	$ 1,000
SUBTOTAL				$ 9,760
ANNUAL REPORT				
Reporting Labor	1	report	$ 6,500	$ 6,500
SUBTOTAL				$ 6,500
SUBTOTAL				$ 16,260
CONTINGENCY			15%	$ 2,439
TOTAL ANNUAL O&M COSTS (Years 2-20)				**$ 18,699**
PRESENT WORTH ANALYSIS				
Number of Years of MNA	19	years		
Effective Interest Rate	3.2%			
COST TYPE	**TOTAL COST**			**PRESENT WORTH**
Capital Cost	$ 770,622			$ 770,622
O&M Cost (Year 1)	$ 83,996			$ 81,391
O&M Cost (Years 2-20)	$ 18,699			$ 245,040
TOTAL PRESENT WORTH COST				**$ 1,097,054**

LS - Lump Sum
lbs - pounds

Figures

\\Aphrodite\proj\USNavFaceNGCom\315007CampLejeune\Projects\Site93_PRAP\Figure 2-1 - Base Location Map.mxd

Legend
- Installation Area
- Environmental Restoration Area
- Operable Unit Area

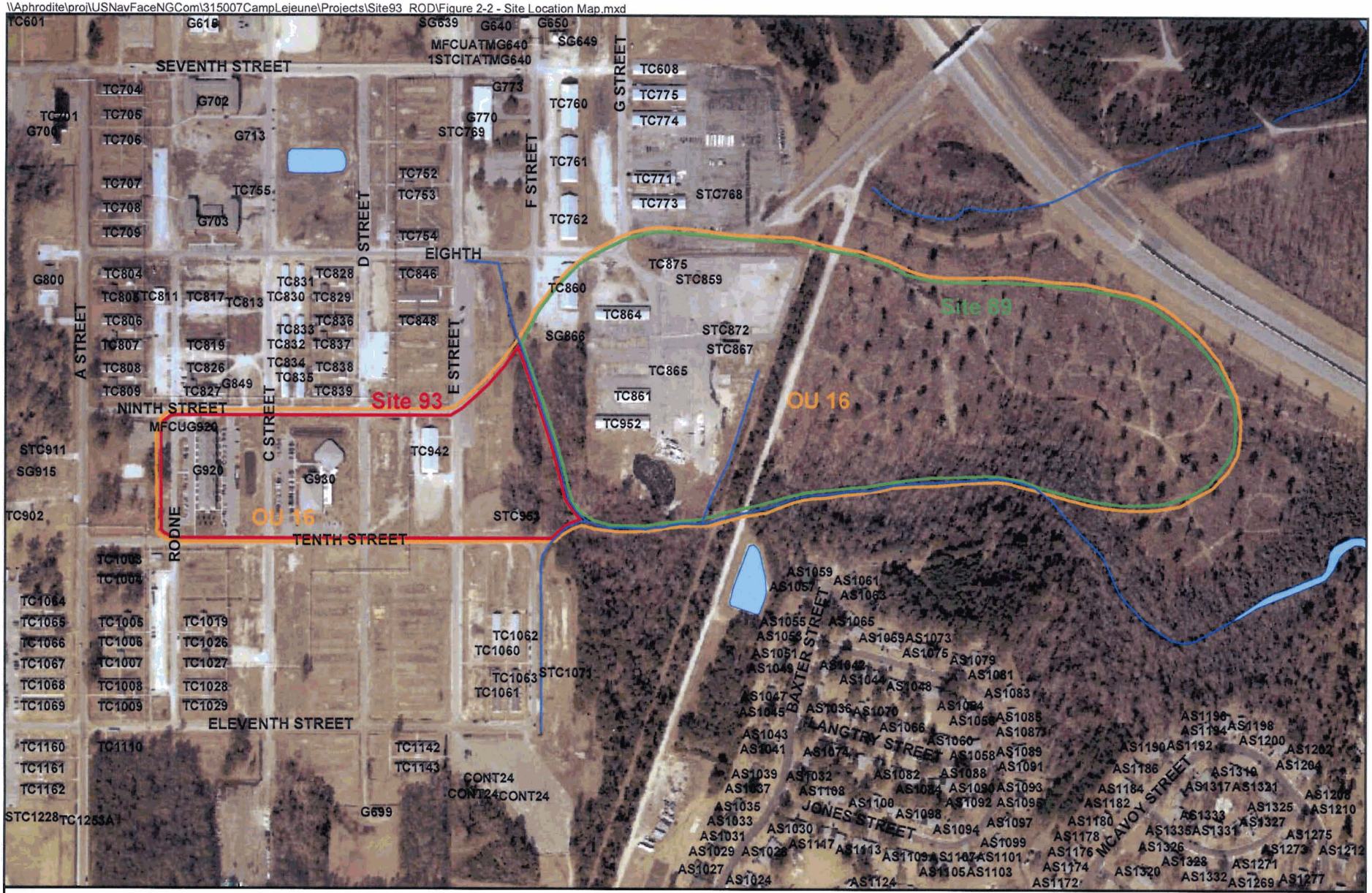
N
W E
S

10,000 0 10,000
Feet

Figure 2-1
Base Location Map
Site 93 Record of Decision
Marine Corps Base, Camp Lejeune
North Carolina

CH2MHILL

\\Aphrodite\proj\USNavFaceNGCom\315007CampLejeune\Projects\Site93_ROD\Figure 2-2 - Site Location Map.mxd



Legend

- Site 93 Boundary
- Site 89 Boundary
- Operable Unit Area

N
W E
S

250 0 250 500
Feet

Figure 2-2
Site Location Map
Site 93 Record of Decision
Marine Corps Base, Camp Lejeune
North Carolina

CH2MHILL

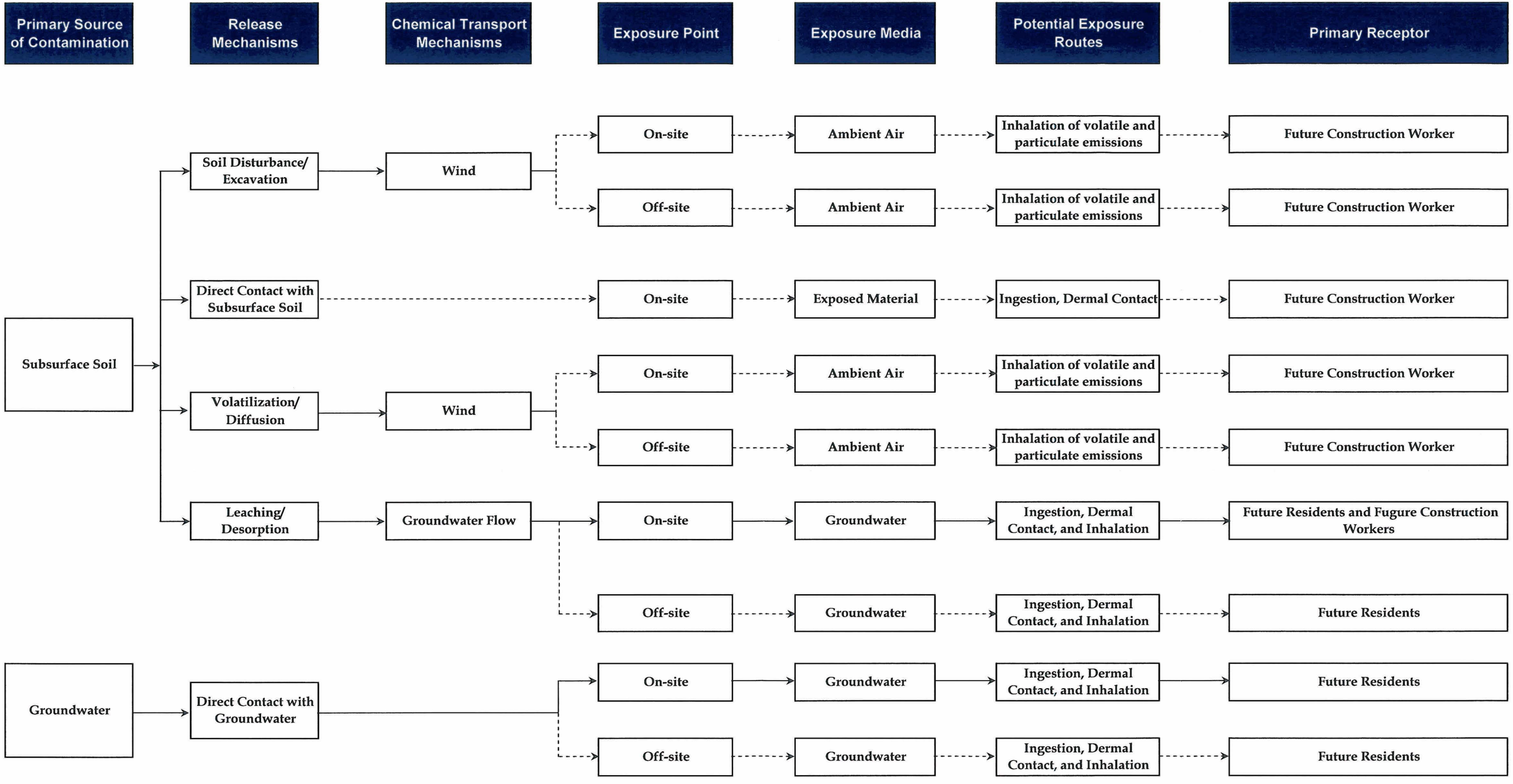
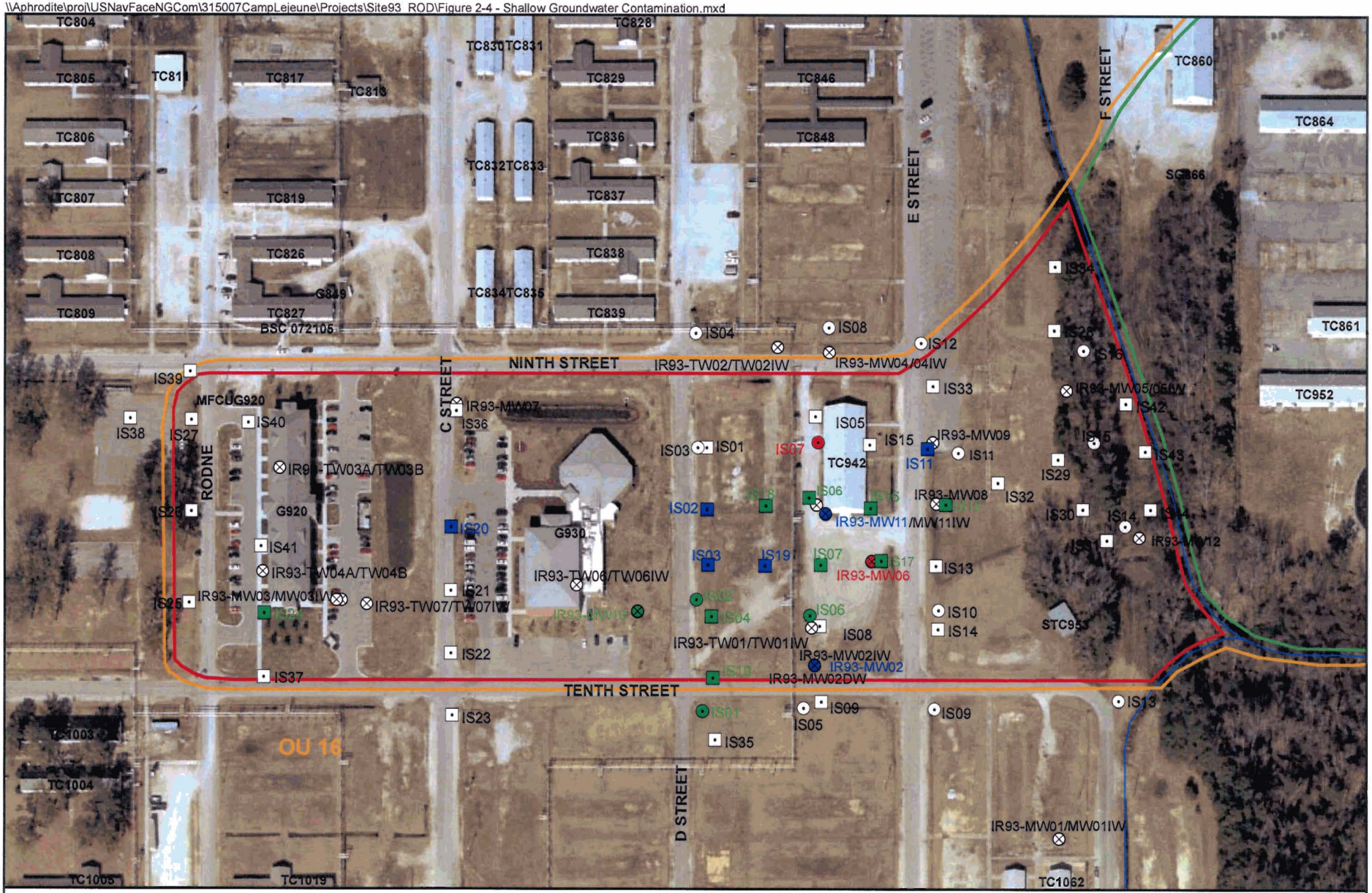


FIGURE 2-3
Conceptual Site Model for Potential Human Exposures
Site 93 Record of Decision
Marine Corps Base Camp Lejeune
North Carolina

\\Aphrodite\proj\USNavFaceNGCom\315007CampLejeune\Projects\Site93_ROD\Figure 2-4 - Shallow Groundwater Contamination.mxd



Legend

- Site 93 Boundary
- Site 89 Boundary
- Operable Unit Area
- ⊗ Monitoring Well Location
- ⊡ Boring Locations 2002
- ⊙ Boring Locations 2004

Blue Color = 1-10x 2L Standard
Green Color = 10-100x 2L Standard
Red Color = 100-1000x 2L Standard
Note: 2L Standard for PCE = 0.7 ug/L.

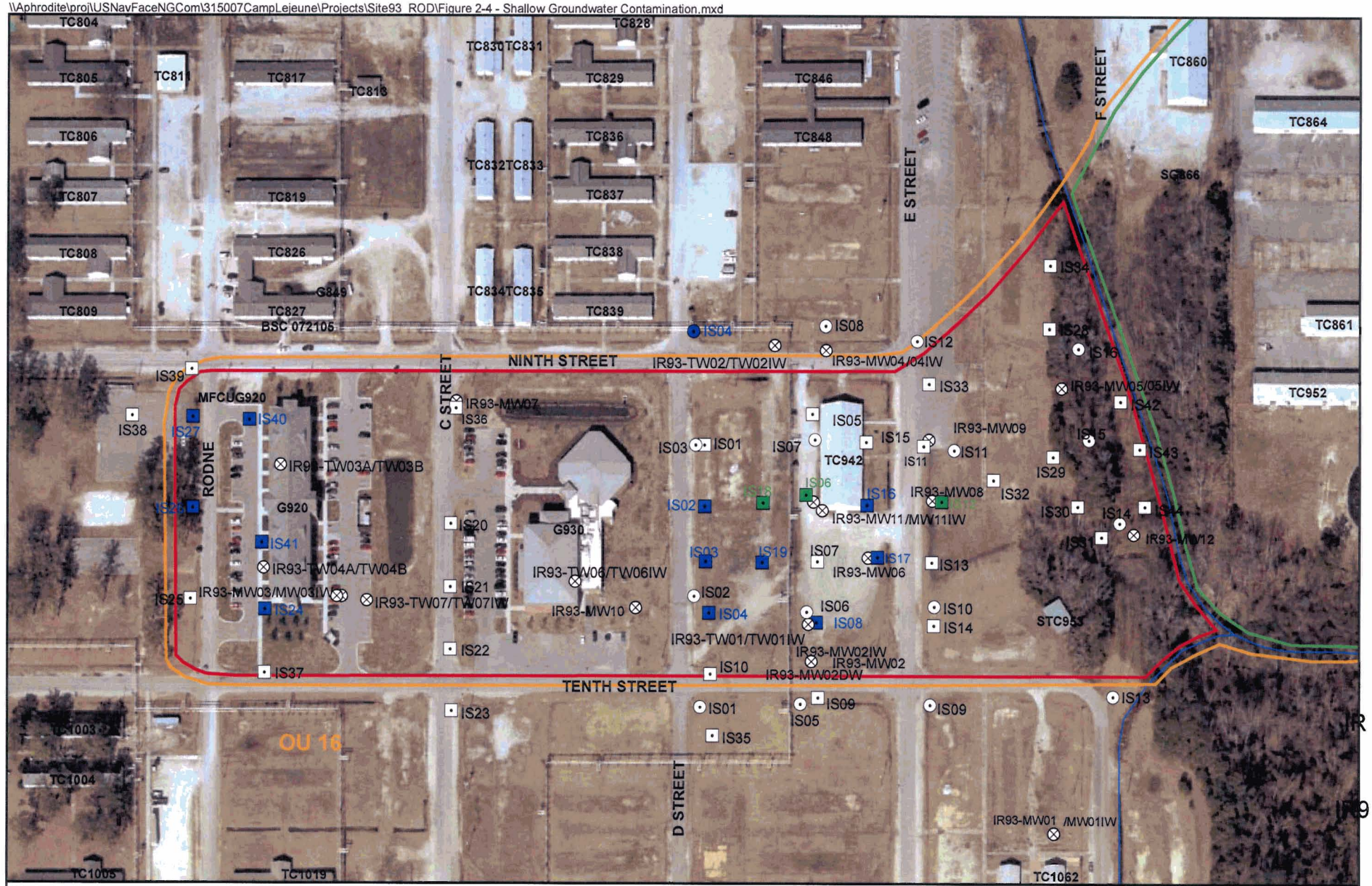
N
W E
S

100 0 100
Feet

Figure 2-4
Extent of PCE in Groundwater
5 to 25 Feet bgs
Site 93 Record of Decision
Marine Corps Base, Camp Lejeune
North Carolina

CH2MHILL

\\Aphrodite\proj\USNavFaceNGCom\315007CampLejeune\Projects\Site93_ROD\Figure 2-4 - Shallow Groundwater Contamination.mxd



Legend

- Site 93 Boundary
- Site 89 Boundary
- Operable Unit Area
- ⊗ Monitoring Well Location
- ⊡ Boring Locations 2002
- ⊙ Boring Locations 2004

Blue Color = 1-10x 2L Standard
Green Color = 10-100x 2L Standard
Note: 2L Standard for PCE = 0.7 ug/L.

N
W E
S

100 0 100
Feet

Figure 2-5
Extent of PCE in Groundwater
25 to 40 Feet bgs
Site 93 Record of Decision
Marine Corps Base, Camp Lejeune
North Carolina

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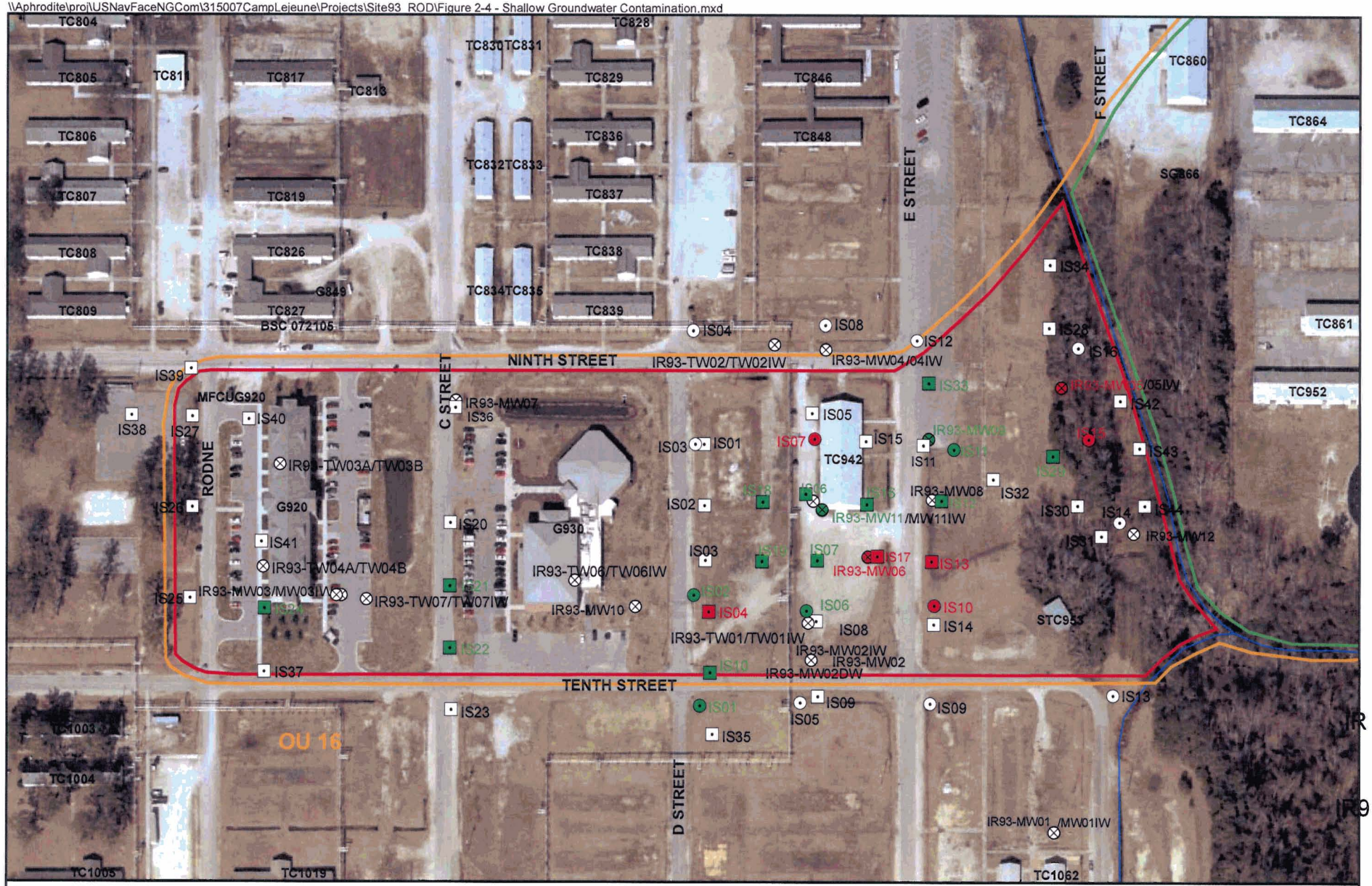
\\Aphrodite\proj\USNavFaceNGCom\315007CampLejeune\Projects\Site93_ROD\Figure 2-4 - Shallow Groundwater Contamination.mxd



Legend

- Site 93 Boundary
- Site 89 Boundary
- Operable Unit Area
- ⊗ Monitoring Well Location
- ⊡ Boring Locations 2002
- ⊙ Boring Locations 2004

Green Color = 1-10x 2L Standard
Red Color = 10-100x 2L Standard
Note: 2L Standard for TCE = 2.8 ug/L.

N
W E
S

100 0 100
Feet

Figure 2-6
Extent of TCE in Groundwater
5 to 25 Feet bgs
Site 93 Record of Decision
Marine Corps Base, Camp Lejeune
North Carolina

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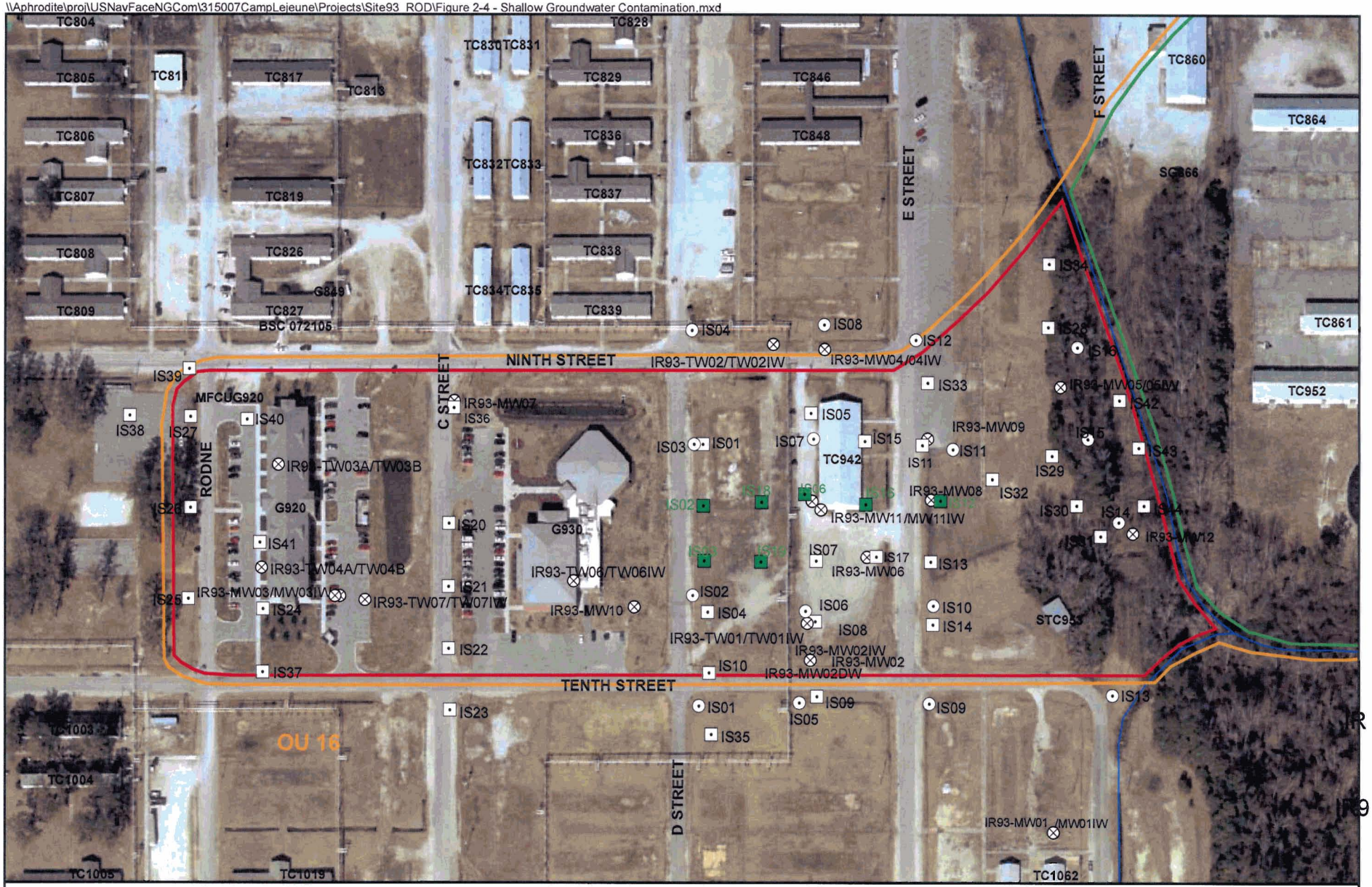
\\Aphrodite\proj\USNavFaceNGCom\315007CampLejeune\Projects\Site93_ROD\Figure 2-4 - Shallow Groundwater Contamination.mxd



Legend

- Site 93 Boundary
- Site 89 Boundary
- Operable Unit Area
- ⊗ Monitoring Well Location
- ⊡ Boring Locations 2002
- ⊙ Boring Locations 2004

Green Color = 1-10x 2L Standard

Note: 2L Standard for TCE = 2.8 ug/L.

N
W E
S

100 0 100

Feet

Figure 2-7
Extent of TCE in Groundwater
25 to 40 Feet bgs
Site 93 Record of Decision
Marine Corps Base, Camp Lejeune
North Carolina

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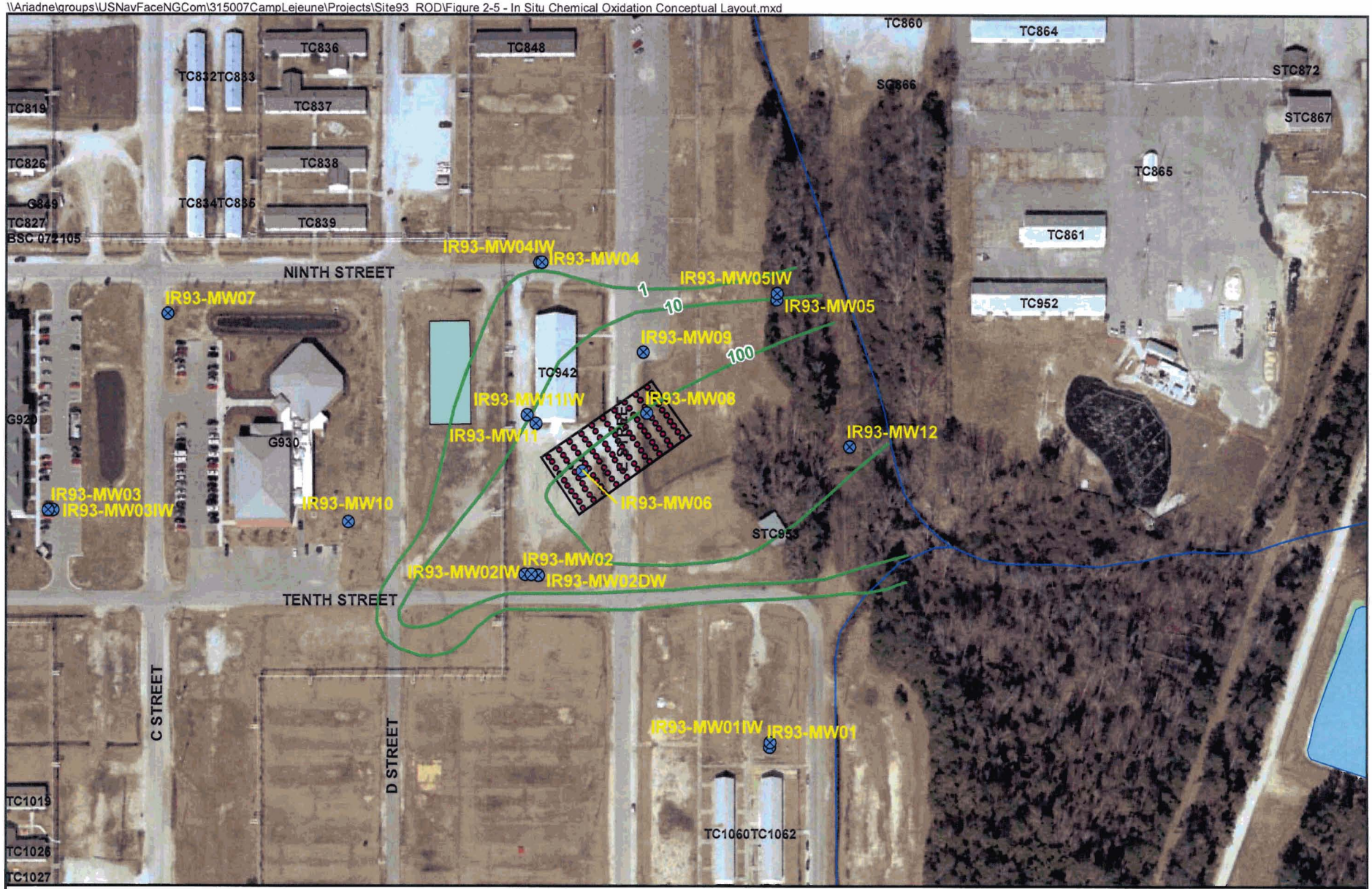
\\Ariadne\groups\USNavFaceNGCom\315007CampLejeune\Projects\Site93_ROD\Figure 2-5 - In Situ Chemical Oxidation Conceptual Layout.mxd



Legend

- Monitoring Well Location
- Contour Line Indicates Concentrations in ug/L
- Geoprobe Injection Borings
- Geoprobe Injection Area
- Former Building TC-940

N
W E
S

250 0 Feet

Figure 2-8
In Situ Chemical Oxidation Conceptual Layout
Site 93 Record of Decision
Marine Corps Base, Camp Lejeune
North Carolina

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\\ariadne\groups\USNavFaceNGCom\315007CampLejeune\Projects\Site93_ROD\Figure 2-9 - LUC/AUC Boundary.mxd

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E = 275448.208193

N = 3846151.294730
E = 275333.108069

N = 3846096.343700
E = 275466.030148

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E = 275233.602155

N = 3846093.373380
E = 275503.159220

N = 3846004.263600
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N = 3845923.907069
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N = 3845914.129589
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E = 275428.901076

EIGHTH

NINTH STREET

TENTH STREET

ELEVENTH STREET

A STREET

RODNE

C STREET

D STREET

E STREET

F STREET

G STREET

CHURCH STREET

BAXTER STREET

JONES STREET

LANGTRY STREET

Boundary of Intrusive Activities
& Site 93 Boundary
65745.840128 sqft.
1.509 316 807 acres

Boundary of Aquifer
Use Control

Legend

- Boundary of Intrusive Activities and Site 93 Boundary
- Boundary of Aquifer Use Control

N
W E
S

0 100 200 300
Feet

Figure 2-9
Boundary of Land Use Controls
Site 93 Record of Decision
Marine Corps Base, Camp Lejeune
North Carolina

CH2MHILL

Appendix A

NCDENR Letter of Concurrence

North Carolina
Department of Environment and Natural Resources
Division of Waste Management

Michael F. Easley, Governor
William G. Ross Jr., Secretary
Dexter R. Matthews, Director

June 10, 2006

NAVFAC Atlantic
Attn: Daniel R. Hood
Code: OPCEV
NC/Caribbean IPT, EV Business Line
6506 Hampton Blvd
Norfolk, VA 23508-1273

RE: State Concurrence on the Record of Decision (ROD)
OU#16, Site 93 - Soil and Groundwater
MCB Camp Lejeune, NC6170022580
Jacksonville, Onslow County, North Carolina

Dear Mr. Hood:

The NC Superfund Section received and reviewed the ROD for Operable Unit #16, Site 93 at MCB Camp Lejeune, dated June 2006 (Should be July 2006) and concurs with the proposed Final ROD. The State's concurrence is based solely on the information contained in the June 2006 Revised Final ROD received July 10, 2006 for OU#16, Site 93. Should we receive additional information that significantly affects the conclusions of the ROD, we may modify or withdraw this concurrence with written notice to the Naval Facilities Engineering Command for Camp Lejeune and the EPA Region IV.

If you have any questions or comments, please contact me, at (919) 508 8464 or email David.Lown@ncmail.net

Sincerely,

David J. Lown, LG, PE
Head, Federal Remediation Branch
Superfund Section

Cc: Randy McElveen, NC Superfund Section
Bob Lowder, EMD/IR
Gena Townsend, USEPA

Appendix B

ARARs Tables

TABLE B-1
Federal Chemical-Specific ARARs
Site 93 Marine Corps Base, Camp Lejeune

Requirement	Prerequisite	Citation	ARAR Determination	Comment
Safe Drinking Water Act (SDWA)				
National primary drinking water standards are health-based standards for public water systems MCLs.	Public water system.	40 CFR 264.94; 40 CFR 141.11 - 141.16; 42 USC 300; 40 CFR Part 141 Subparts B & G	Relevant and Appropriate	Site remedial action objectives are to prevent human ingestion of water containing contaminants of concern at concentrations above 2L standards or MCLs, whichever is more conservative.

Note: Statutes and policies, and their citations are provided as headings to identify general categories of potential ARARs for the convenience of the reader. Listing the statutes and policies does not indicate that the Department of the Navy accepts the entire statutes or policies as potential ARARs. Specific potential ARARs are addressed in the table below each general heading; only substantive requirements of the specific citations are considered potential ARARs

ARAR – Applicable or Relevant and Appropriate Requirement
CFR – Code of Federal Regulations
MCL – Maximum Contaminant Level
USC – United States Code

TABLE B-2
North Carolina Chemical-Specific ARARs
Site 93 Marine Corps Base, Camp Lejeune

Requirement	Prerequisite	Citation	ARAR Determination	Comment
Environmental Management				
Established to protect the overall high quality of North Carolina's groundwaters to the level established by the standards and to enhance and restore the quality of degraded groundwaters where feasible and necessary to protect human health and the environment, or to ensure their suitability as a future source of drinking water.	Potential drinking water source.	15A NCAC 02L.0200	Applicable	Site remedial action objectives are to prevent human ingestion of water containing contaminants of concern at concentrations above 2L standards or MCLs, whichever is more conservative.
Established to protect the overall high quality of North Carolina's surface waters and wetlands to the level established by the standards necessary to protect human health and the environment, or to meet and maintain uses such as swimming and other water-based recreation, public water supply, and the propagation and growth of aquatic life.	State surface waters designated for aquatic life or human uses.	15A NCAC 02B.0100, .0200, & .0400	Applicable	Edwards Creek is located near and within the Operable Unit boundaries. Site remedial action objectives may involve or require discharges to surface water. Engineering controls shall address potential impacts during remedial activities.

Note: Statutes and policies, and their citations are provided as headings to identify general categories of potential ARARs for the convenience of the reader. Listing the statutes and policies does not indicate that the Department of the Navy accepts the entire statutes or policies as potential ARARs. Specific potential ARARs are addressed in the table below each general heading; only substantive requirements of the specific citations are considered potential ARARs

ARAR – Applicable or Relevant and Appropriate Requirement
NCAC – North Carolina Administrative Code
MCL – Maximum Contaminant Level

TABLE B-3
Federal Location-Specific ARARs
Site 93 Marine Corps Base, Camp Lejeune

Location	Requirement	Prerequisite	Citation	ARAR Determination	Comment
Federal Endangered Species Act					
Endangered Species	Requires action to avoid jeopardizing the continued existence of listed endangered species or modification of their habitat.	Applies to actions that affect endangered species and their habitat.	16 USC 1531; 50 CFR 200; 50 CFR 402	Relevant and Appropriate	Many protected species have been sited near and on MCB Camp Lejeune. Engineering controls shall address potential impacts to endangered species and the habitats.
Federal Fish and Wildlife Conservation Act					
Fish and wildlife	Requires that activities avoid, minimize, or compensate for impacts to fish and wildlife and their habitats.	Applies to actions that affect fish and wildlife and their habitat.	16 USC 661-666	Applicable	Edwards Creek is located near and within the Operable Unit boundaries. Engineering controls shall address potential impacts to fish and wildlife and their habitats.
Protection of Floodplain					
Within floodplain	Establishes special requirements for federal agencies to evaluate the adverse impacts associated with direct and indirect development of a floodplain.	Action that will occur in a floodplain.	EO 11988; 40 CFR 6	Relevant and Appropriate	Site 93 is primarily within a minimal flooding zone; however, the immediate areas around Edwards Creek are within the 100-year floodplain.
Protection of Wetlands					
Wetland	Establishes special requirements for federal agencies to avoid adverse impacts associated with destruction or loss of wetlands and to avoid support of new construction in wetlands.	Wetland	EO 11990; 40 CFR 6	Applicable	Federal or State regulated wetlands are present at the site which could be impacted by the remedial action. All appropriate measures shall be taken to ensure wetland protection.
Resource Conservation and Recovery Act					
Hazardous waste	Establishes limitations on where on-site storage, treatment, or disposal of RCRA hazardous waste may occur.	Hazardous waste storage, treatment or disposal.	40 CFR 264.18	Relevant and Appropriate	Site remedial actions may include on-site storage of RCRA hazardous waste. All appropriate measures shall be taken.

Note: Statutes and policies, and their citations are provided as headings to identify general categories of potential ARARs for the convenience of the reader. Listing the statutes and policies does not indicate that the Department of the Navy accepts the entire statutes or policies as potential ARARs. Specific potential ARARs are addressed in the table below each general heading; only substantive requirements of the specific citations are considered potential ARARs

ARAR – Applicable or Relevant and Appropriate Requirement
CFR – Code of Federal Regulations
EO – Executive Order
USC – United States Code

TABLE B-4
North Carolina Location-Specific ARARs
Site 93 Marine Corps Base, Camp Lejeune

Location	Requirement	Prerequisite	Citation	ARAR Determination	Comment
North Carolina Endangered Species Act					
Endangered Species	Requires action to avoid jeopardizing the continued existence of listed endangered species, State special concern species, State significantly rare species, and the State watch list.	Applies to actions that affect endangered species and their habitat	NCGS 113-331 to 113-337	Relevant and Appropriate	American alligator has been sighted within the Base. Engineering controls shall address potential impacts to endangered species and the habitats.
North Carolina Hazards Waste Management Rules					
Hazardous Waste	Location requirements and land disposal restrictions for hazardous waste excavated, stored, and/or treated on site.	Hazardous waste excavation, storage, or treatment.	15A NCAC 13A	Relevant and Appropriate	Site remedial actions may include on-site storage of hazardous waste. All appropriate measures shall be taken.
North Carolina Solid Waste Management Rules					
Solid Waste	Location requirements and land disposal restrictions for solid waste excavated, stored, and/or treated on site.	Solid waste excavation, storage, or treatment.	15A NCAC 13B	Relevant and Appropriate	Site remedial actions may include off-site disposal of solid waste. All appropriate measures shall be taken.
North Carolina Recordation of Inactive Hazardous Substance or Waste Disposal Sites					
Hazardous Waste	Establishes requirements for recordation of inactive hazardous waste sites.	Land disturbing activities	NCGS 130A-310.8	Applicable	Site remedial actions will include Land Use Controls requiring recordation of inactive hazardous or waste disposal sites.

Note: Statutes and policies, and their citations are provided as headings to identify general categories of potential ARARs for the convenience of the reader. Listing the statutes and policies does not indicate that the Department of the Navy accepts the entire statutes or policies as potential ARARs. Specific potential ARARs are addressed in the table below each general heading; only substantive requirements of the specific citations are considered potential ARARs

ARAR – Applicable or Relevant and Appropriate Requirement
NCAC – North Carolina Administrative Code
NCGS – North Carolina General Statute

TABLE B-5
Federal Action-Specific ARARs
Site 93 Marine Corps Base, Camp Lejeune

Action	Requirement	Prerequisite	Citation	ARAR Determination	Comment
Safe Drinking Water Act (SDWA)					
Injection	Establishes requirements for underground injection.	Underground Injection	40 CFR 144, 146, 147, 268	Applicable	Remedial action includes injection of reagent into groundwater. The appropriate UIC process will be implemented prior to injection.
Department of Transportation (DOT)					
Transportation of hazardous waste	Regulates transportation of hazardous waste.	Off-site transport of waste.	49 CFR 107	Relevant or Appropriate	Any hazardous waste to be transported off-site will be transported in accordance with the regulations.

Note: Statutes and policies, and their citations are provided as headings to identify general categories of potential ARARs for the convenience of the reader. Listing the statutes and policies does not indicate that the Department of the Navy accepts the entire statutes or policies as potential ARARs. Specific potential ARARs are addressed in the table below each general heading; only substantive requirements of the specific citations are considered potential ARARs

ARAR – Applicable or Relevant and Appropriate Requirement
CFR – Code of Federal Regulations
UIC – Underground Injection Control

TABLE B-6
North Carolina Action-Specific ARARs
Site 93 Marine Corps Base, Camp Lejeune

Action	Requirement	Prerequisite	Citation	ARAR Determination	Comment
North Carolina Groundwater Corrective Action					
Groundwater remediation	Establishes regulations for cleanup of contaminated groundwater.	Contaminated groundwater	15A NCAC 2L .0106	Applicable	Applicable for any site remediation activities involving groundwater remediation. Site remedial action objectives are to prevent human ingestion of water containing contaminants of concern at concentrations above 2L standards or MCLs, whichever is more conservative.
North Carolina Well Construction Standards					
Construction of water wells	Establishes construction and abandonment requirements for water wells.	Well construction	15A NCAC 2C .0100	Relevant and Appropriate	The remedial action may include installation or abandonment of monitoring wells.
North Carolina Injection Well Construction Standards					
Construction of injection wells	Establishes construction and abandonment requirements for injection wells.	Injection well construction	15A NCAC 2C .0200	Relevant and Appropriate	The remedial action may include installation of injection wells.
North Carolina Hazardous Waste Management Rules					
Hazardous waste management	Establishes design and treatment requirements for hazardous waste.	Land disturbing activities.	15A NCAC 13A	Relevant and Appropriate	Site remedial actions may include on-site storage of hazardous waste. All appropriate measures shall be taken.
North Carolina Solid Waste Management Rules					
Solid waste management	Establishes storage, collection, transportation, and disposal of solid waste.	Land disturbing activities	15A NCAC 13B	Relevant and Appropriate	Site remedial actions may include off-site disposal of solid waste. All appropriate measures shall be taken.

Note: Statutes and policies, and their citations are provided as headings to identify general categories of potential ARARs for the convenience of the reader. Listing the statutes and policies does not indicate that the Department of the Navy accepts the entire statutes or policies as potential ARARs. Specific potential ARARs are addressed in the table below each general heading; only substantive requirements of the specific citations are considered potential ARARs

ARAR – Applicable or Relevant and Appropriate Requirement
UIC – Underground Injection Control

Appendix C

PRAP Public Meeting Summary: February 16, 2006

PROPOSED REMEDIAL ACTION PLAN
FOR
SITE 93, OPERABLE UNIT 16 and
SITE 94, OPERABLE UNIT 18
AT
MARINE CORPS BASE CAMP LEJEUNE
JACKSONVILLE, NORTH CAROLINA

PUBLIC MEETING

FEBRUARY 16, 2006

CONDUCTED AT COASTAL COMMUNITY COLLEGE, ROOM CB-121, 444 WESTERN BOULEVARD, JACKSONVILLE, NORTH CAROLINA.

CAROLINA COURT REPORTERS, INC.
105 Oakmont Professional Plaza
Greenville, North Carolina 27858
TEL: (252) 355-4700 (800) 849-8448
FAX: (252) 355-4707

MR. CHRIS BOZZINI: Does everyone have a handout, because there's some figures in this presentation that are gonna be impossible to read, so a handout is better for that. And then the only other rule is, if you ask a question, if you can state your name so the gentleman recording it will have a record of who asked a question and so forth. With that said, the first presentation tonight is the proposed remedial action plan for Site 93. The purpose of this presentation is to provide a history of the site, present the proposed remedial action plan, and to properly identify preferred alternative for addressing the contamination that's present at the site, and it explains the rationale of, basically, the decision-making process. And then we'll ask -- we'll answer any questions and begin the community feedback for the site. This is no good. Why don't you refer to the figures in your handout. It'll be much easier. So Figure 1 shows Site 93. Site 93's at Camp Geiger. It's part of OU16. OU16 is comprised of Site 89, which is the former VRO, and there's a little drainage swell, and Site 93 is west of Site 89. So -- let's go back; I'm sorry. And you can see this inset is the boundary of Site 93, on this satellite photo, and that's the former VRO. The history of the site, basically, there was an underground storage tank at Building -- I believe it's 942. A 500-gallon underground storage tank was removed in 1993. Chlorinated

solvents were detected in the groundwater during the investigation. The remedial investigation was conducted in 1998. This consisted of soil sampling, groundwater sampling, human health risk assessment, ecological assessment. And, basically, the general conclusion was chlorinated solvents in the groundwater. In 2002 there was additional groundwater evaluations, went out there with the geoprobe to collect groundwater samples across the site. Once again, basically, the goal on that was to delineate the plume -- the contaminated plume. Basically, this figure shows the site with the latest groundwater data that was from 2005, approximately about a year ago; I believe that was January of 2005. And this is Figure 3 in your handout -- oh, excuse me -- yeah, Figure 3. So it'll be easier to understand. These call outs are the concentrations in parts per billion, PCE is tetrachloroethane. TCE is trichloroethane. cis-1,2-DCE is dichloroethane, and VC is vinyl chloride. TCE is basically a solvent -- cleaning solvent, and the VC, vinyl chloride, is degradation products. When you look at the figure, the hottest well is MW6, which is just south of Building 942, and those concentrations are 180 parts per billion of TCE and 540 parts per billion of DCE. The risk assessment that was conducted for the site basically identified groundwater at an unacceptable risk. In addition, the groundwater also exceeds the North Carolina Groundwater Protection Standards. We have

a table that's showing the maximum concentrations. Once again, that's the MW6 of, like I said, 180 parts per billion TCE plus the degraded products. The partnering team, which is comprised of the Navy, the base, EPA and the State, agrees that the groundwater is the primary risk factor -- primary risk posed at the site. A feasibility study was completed late in 2005. It was final. The goal of the study was to evaluate technologies to address the chlorinated problem plume. The alternatives that were evaluated was no action, which is a baseline evaluation that we used. Second alternative was a permeable reactive barrier wall. Basically, you dig a trench to, say, 25-30 feet, back-fill it with a material that will react with the contaminant. Next was in situ chemical reduction, which would be basically inject a chemical-reducing agent that will remove -- basically make the materials less toxic. It breaks them up. In situ chemical oxidation, it is similar. It's basically injecting an oxidant that breaks the chemical bond and destroys the contaminant. And lastly, we looked at air sparging, which is basically you install wells and blow in air. You basically volatilize your chemicals out of the groundwater. We did this evaluation based on EPA guidance. There's nine criteria. The first two criteria -- threshold criteria are overall protectiveness of human health and the environment and compliance with the applicable and

appropriate relevant requirements. The secondary criteria are long-term effectiveness and permanence and reduction in toxicity, mobility or volume of the contaminants, short-term effectiveness, implementability and cost. And then the final criteria, the last two, are state acceptance and community acceptance. So we're here tonight to begin the community acceptance portion. This table, which is also in the PRAP, is on page 8, Table 4. It's just a relative qualitative approach to looking at the different technologies and how they stack up as far as being protective -- meeting those nine criteria. Complying with the requirements, the regulations, long- and-short term effectiveness, reducing mobility, et cetera. The preferred alternative: the partnering team selected in situ chemical oxidation combined with natural monitoring -- monitoring natural attenuation. And the proposed action -- once again, I probably should show -- maybe we don't have this with you -- no; okay. Basically, the proposed action calls for injecting permanganate, which is a chemical oxidant. And we'd drive a 200- by 100-foot grid over the highest concentration area of the plume. The action will require the injection of permanganate and then monitoring the plume to see how well the system worked and to evaluate the natural attenuation of the plume itself. Community participation, which is why we're here tonight, the community acceptance portion: public

notice was placed on February 1st and February 2nd in the Jacksonville Daily News and the Globe. Comments are being solicited in the record. We have a public comment period that begins tonight and lasts for 30 days. The PRAP is available for review in the administrative records and there's also a copy in the library, plus we have 20 or 30 copies here tonight, but I think everybody has a copy of it. The community participation, during the comment period you get to submit written comments to any of the following: Gena Townsend with EPA, Randy McElveen with the State of North Carolina, Daniel Hood with the Navy, and Mr. Bob Lowder with the base. The path forward: the path forward is -- for the public comment period -- is to review any comments and respond to them appropriately. If the notification substantially changes the proposed remedy, then we may have an additional comment period to address those questions or issues or concerns that may be raised. The partnering team, which is the Navy, the base, EPA and the State, will make a final decision remedy and issue a ROD that comprises the public response here in the acceptance portion, and the ROD will be issued. Once the ROD is completed and signed, the public will be notified on the administrative record, which should have all the official documentations for the site, you know, investigation reports, feasibility studies, et cetera. It is all on the administrative record. And once again, this

is at the local library. In addition, the community participation is -- I think this is kind of general stuff that, actually, we've gone over at the beginning was -- Restoration Advisory Board formed in 1995. The Navy solicits input from the RAB and informs the community, serving as -- you know -- informative environmental activities on the base. And there is a response input plan for the base that provides the information concerning this participation, and this public comment period allows the community to provide input into the RAB. Any questions?

MR. MARVIN POWERS: Marvin Powers. Looking at your chart here on page 8, are you going with the No. (4)?

MR. CHRIS BOZZINI: Yes, sir.

MR. MARVIN POWERS: Why (4) over (3)? (3) looks like it'd be more effective here and cheaper. Or am I reading it wrong?

MR. CHRIS BOZZINI: We are doing (4).

MR. MARVIN POWERS: Right. But the (3) is looking -- (3b) would be cheaper and be more effective. In short term -- it's more effective in short term.

MR. CHRIS BOZZINI: Hold on. I think there might be a typo, because the chemical oxidation was the cheapest. You know, the problem is those symbols aren't good symbols.

MR. TOM MATTISON: Tom Mattison, RAB member. I

was gonna ask you about this chart. Why in the world can't you put this in some kind of context that's readable?

MR. DANIEL HOOD: Maybe Table 3 is a better table. Look at Table 3. It's a better table. It actually has the dollar amount in it. The page before.

MR. CHRIS BOZZINI: Okay. So the first question, as far as the cost, I think that Table 4 is -- I don't want to use the word "deceptive," but it's difficult to understand as far as the cost of it. In the cost detail that's provided in Table 3, with the capital cost and the operation and maintenance --

MR. MARVIN POWERS: How about the short-term effectiveness? It's higher on (3) than it is on (4) according to this chart.

MR. CHRIS BOZZINI: That's correct. Basically, Table 4 is a relative ranking. It is somewhat -- you know, when we look at the technical facts and so forth, you know, the feeling is -- we have used chemical oxidation at the site at the base in general. It has had, not smashing results, but not bad results. So we think it is a viable technology, and in the short term the biggest issue with the chemical oxidation is the chemical itself is a little more hazardous, and it requires a little additional care in handling. It's a strong oxidant, so there are safety issues for workers; whereas, the reduction material is really just an iron powder

that's rather inert. So short-term effectiveness takes into account issues of, like, short-term health and safety of the remedy itself.

MR. RANDY McELVEEN: I remember there was some concern about the reductive material -- the chemical reduction being clogged up, potentially, before it could be taken to a treatment site, and there are some questions I have if we can take a moment?

MR. CHRIS BOZZINI: So the primary drawback in the short term is the chemical oxidation has a higher safety issue for the site workers handling the material, but it's really -- you know, we feel it could be as effective -- both technologies can be effective out there, and the overall cost was slightly cheaper for the chemical oxidation. So that's how the -- all things being equal, you take the one with the lower cost.

MR. RANDY McELVEEN: Well, the plume is not that big, it's big but not as big as some of these places that we'll treat -- and we're going to be able to treat -- the plume is not so big that we'll be able to get 100 EPC, and that's pretty low for that type of stuff. It wasn't a real big bad, bad plume or anything.

MR. RICHARD MULLINS: Rick Mullins, RAB member. Actually, this chart answered my question, too. I was wondering often -- you know, how deep this stuff went and all

that, and it's right there in the chart. This is a one-time shot, right?

MR. CHRIS BOZZINI: That's exactly right. That was --

MR. RICHARD MULLINS: You put in your 92,000 pounds of permanganate and then let it work and watch it?

MR. CHRIS BOZZINI: And monitor it; exactly. That was -- the partner team -- which once again is State, EPA, the Navy and the base -- basically defined to go out there, inject one time, and monitor it over time. And the CERCLA process requires a five-year review, so if something -- additional work needs to be done, the five-year review will test that and --

MR. RICHARD MULLINS: Well, mine were mostly curiosity questions like how many sticks you got and how deep they went and it's all right here in the chart, and I didn't realize it.

MR. CHRIS BOZZINI: Right. And, frankly, the details provided in the chart, a lot of it is just assuming that we use a cost basis; we think, you know, we can inject this stuff ten feet. The reality is it might only go five feet or if it goes fifty. A lot of that, you know, is played out during the actual implementation.

MR. RANDY McELVEEN: We've got the actual feasibility studies on the website. If they want to look at

-- if they want to see the specific layout of the plume.

MR. CHRIS BOZZINI: Any --

MR. RAY HUMPHRIES: Ray Humphries, RAB member. How deep are your aquifers there? In other words, how deep is the impacted area out there?

MR. CHRIS BOZZINI: The contaminated groundwater that we're talking about is the surface aquifer. It begins at about eight feet and goes down to about 20, 25 feet from ground surface. That's where we're seeing the highest contamination.

MR. JEROME ENSMINGER: Jerry Ensminger, RAB. It says something here -- something about the pollution of Edwards Creek?

MR. CHRIS BOZZINI: Well, what I was gonna say is -- Matt, if you can go to the site map. Yeah. Basically, the -- go to the one that's our Figure 3, if you could. Yeah. Basically, the contamination is from, like, 8 to 20, 25 feet, and it's going into a northeastern direction. And basically discharging through the -- it's really kind of a drainage creek that just kind of fills up over the distance. And this creek wraps around Site 89 and then heads to Edwards Creek.

MR. MATT LOUTH: Figure 3, go to figure 3.

MR. CHRIS BOZZINI: Now -- yeah, Figure 3 begins --

MR. MATT LOUTH: And then turns into a stream the farther down it gets --

MR. CHRIS BOZZINI: Well, I guess we don't have it. If you look at Figure 2 of your document, you'll see how the stream basically travels. It begins in a north-to-south direction, then it turns eastwardly going to the creek. Now to answer Mr. Ensminger's question, that swell creek is actually being impacted by both Site 93 and Site 89. And, frankly, Site 89 has much higher a level of solvents in the water, and that is contributing much more than this site is. Now, that being said, we are investigating and looking at these other studies for Site 89 --

MR. DANIEL HOOD: That's where we did the ERH and that's also where we've -- have -- we also have installed an air stripper in the creek itself downstream from this right at the dirt road if you look at the pictures. The aeration system's in the creek right now to help handle some of the solvents that make it into the creek so we can get both these sites cleaned up.

MR. CHRIS BOZZINI: Who's that?

MR. DANIEL HOOD: Daniel Hood, Department of the Navy.

MR. CHRIS BOZZINI: Are there any additional questions?

MR. JEROME ENSMINGER: What's that pond over

there on it?

MR. CHRIS BOZZINI: The pond that's south of Site 89?

MR. JEROME ENSMINGER: Yes.

MR. CHRIS BOZZINI: That is -- Bob?

MR. ROBERT LOWDER: Yeah, that's some type of water treatment. I think it's a -- it's a lime type of pond. I'm not sure what the waste -- or, the water treatment plant uses it for.

MR. RANDY McELVEEN: That's part of the base.

MR. ROBERT LOWDER: Oh, yeah, I believe it's fenced in.

MR. RANDY McELVEEN: It is fenced in. It is --

MR. ROBERT LOWDER: And it's got some nasty green slime on it.

MR. RANDY McELVEEN: Well, it's lime discharge from the water treatment plant. I think they use it as a holding pond.

MR. JEROME ENSMINGER: A retention pond.

MR. ROBERT LOWDER: That's -- Bob Lowder; I don't think that would be deemed as recreational use or anything. Once again, I'm almost positive it's fenced in so access would be -- there'd be no access to it and so forth.

MR. CHRIS BOZZINI: Any other questions?

MR. RANDY McELVEEN: I was just gonna say the

public comment period is starting February 16th and runs through March 16th if any of you guys want to come by and take a look at this and make a comment on it.

MR. CHRIS BOZZINI: Yeah, page 10 has -- all right. If there's no other questions on Site 93, moving to 94.

MR. RICHARD MULLINS: Are these buildings -- under Site 93 -- are they occupied at the present?

MR. CHRIS BOZZINI: Site 93? Yes, they are. They have warehouse-type facilities and training facilities out there for a TC.

MR. DANIEL HOOD: They are getting ready to tear a couple of them down and build a new armory.

MR. RICHARD MULLINS: The same thing under Site 89?

MR. CHRIS BOZZINI: Nothing at Site 89. That's not within our boundaries.

MR. JEROME ENSMINGER: Has anybody tested these under Site 93 for vapor intrusion into the buildings?

MR. CHRIS BOZZINI: Vapor intrusion? There's no vapor intrusion in those areas there. If you actually look at the plume for Site 93, the constituent concentrations there, it really doesn't warrant vapor intrusion type investigation for this type of site. The amount of contamination. There's actually a list out there where you

screen buildings for vapor intrusion testing, and this would fall out of that screening criteria.

MR. RANDY McELVEEN: They went through a screening process on all the sites -- or all the sites on the base -- or several of them fall under that, what, two years --two or three years ago?

MR. ROBERT LOWDER: Three years ago we assessed every building that had a plume near it and a certain distance -- I think it's -- I'm thinking back in my mind right now -- I think it's 100 -- anything that's 100 feet from the building vertically or horizontally, a plume, and the constituents had to be at a certain level to go ahead and screen that --

MR. JEROME ENSMINGER: What are the -- where is the criteria published at?

MR. CHRIS BOZZINI: EPA.

MR. ROBERT LOWDER: EPA has that. That's Gena Townsend's responsibility.

MS. GENA TOWNSEND: There is a -- they call it a draft final guidance evaluation. It hasn't been finalized, but it's a good document to use. You can pull it up on the internet -- I believe it was called soil vapor guidance.

MR. ROBERT LOWDER: And we did some screening, like Randy said, about three years ago, and he has that data.

MR. RANDY McELVEEN: They did -- I think Site

88-A was in that category, and it came up good.

MR. JEROME ENSMINGER: At some places it's not coming up good.

MR. RANDY McELVEEN: That's right; that's true. That's right next door and that's why we check those and make extra sure.

MR. MATT LOUTH: Okay. Any other questions regarding 93, or discussion? Okay. We'll move right into the -- you need 94? Okay. All right. Let's get into Site 94. Basically, the public meeting for Site 94. Site 94 is considered OU18 under the IR program, and, basically, it is the PCX service station on base, so there's 1613. Its presentation is gonna follow the very same format as Site 93 as far as giving the history of the site, present the proposed remedial action plan for the site, which, as Chris indicated, identifies preferred alternatives for addressing potential contamination of the site and also the PRAP, which explains the rationale for selecting the alternative, and then, you know, talk about answering questions and see the community feedback and acceptance of the preferred alternative. Site 94 is OU -- it lies within OU1 at the base. This is Holcomb Boulevard right here, coming in the main gate, would be right here. Holcomb Boulevard here. The service gas station on base. And Site 94 lies within OU1 under the IR program, which is Site 78, so that's your

general location of Site 94, and you can see on the bigger map how it's within the OU1 area as well. Basically, the history and previous investigations for Site 94, it started out -- the history is as a service station on base which has been in operation since the 1950s. Basically, there were two 10,000-gallon tanks, two 30-gallon underground storage tanks storing various gasolines at the service station to provide gas for the center there. Those USTs were removed in 1995 as part of the UST program. Sampling was conducted that indicated that the USTs had been leaking, so under the UST program, petroleum hydrocarbons were detected exceeding the groundwater standards for the State of North Carolina. So additional soil and groundwater sampling was conducted at the site to assess the leaking USTs. As part of that sampling, chlorinated solvents were detected within the groundwater. The decision was made by the partnering team to move the site into the IR program to look at, since there were chlorinated solvents within the groundwater at the site. So a remedial investigation was conducted in 2004, and that investigation included soil and groundwater samples in the vicinity of Site 94. In addition, as part of that investigation, we did a complete groundwater sampling of OU1 as well so we could get a good snapshot picture of what was happening around Site 94 as well as what was happening at Site 94, what factors might be impacting Site 94. Chlorinated volatile organic compounds

were detected at Site 94, but they were attributed to OU1, which is Site 78, on base, which where OU1, Site 78, does have a remedial technology in place to treat the chlorinated solvents that was in the groundwater. Basically, the RI environmental sampling consisted of 16 soil samples, 36 groundwater samples from monitor wells, and in addition we did 46 groundwater samples from direct push borings as well. And the components of the remedial investigation included nature and extent of the contamination within Site 94, human health risk assessment, an ecological risk assessment. And, basically, coming from the remedial investigation, the recommendation was made for no further action at Site 94 due to the lack of soil contamination and also groundwater contamination related to Site 94. The risk assessment for Site 94 indicated that there was unacceptable risk for groundwater, but it was attributed to Site 78, which is OU1, which is currently under the remedial action, with the groundwater --

MR. RANDY McELVEEN: You can see that on Figure 2. The orange line there -- it's the smaller area within this huge area.

MR. MATT LOUTH: That's correct. Basically-- could we put this back up on the screen?

MR. RANDY McELVEEN: Our Figure 2 doesn't have all the little lines like that. It just has the orange

outline.

MR. MATT LOUTH: Yeah. Basically, this figure here is showing all of the environmental samples collected during the remedial investigation, both the monitor wells, the DPT groundwater samples and soil sample locations. Basically, you can see how we ensured that we had good distribution of soil data, groundwater data across the site, both up-gradient and down-gradient and lateral-gradient for this site.

MR. JEROME ENSMINGER: What were the results of your samples if they are not in here?

MR. CHRIS BOZZINI: They are -- they are summarized in our remedial investigation and, basically, they were all below a soil for screening criteria. The groundwater data for VOCs exceeded the State 2L standards for TCE. However, those concentrations were not attributed to the facility activities for Site 94 being a service station. The control of the contamination related to a leaking UST being cleaned up under the UST program, but by the base -- the Navy. And all that is on the admin record as far as the remedial investigation with all the sampling data, lab reports written up.

MR. RANDY McELVEEN: See the web page there on page 7 there, http://baker. If you go to that website, you can pull up the borings and type of data and all kinds of

stuff that you can look at. I think how you get there is just the site name, like, Site 94.

UNIDENTIFIED PERSON: Which was the adjacent site that -- DOC called --

MR. MATT LOUTH: Site 78.

MR. DANIEL HOOD: Yeah. Chris, if you could go back to the -- okay. This is Site OU1, which has Site 78 within that. It's a very large area which had not been --

MR. JEROME ENSMINGER: The whole place is contaminated.

MR. RANDY McELVEEN: And that's what happened. The U.S. State program, during their investigation, made natural triggers for them that they find chlorinated solvents, no matter what the source. If they find them, they're supposed to turn it over to the IR program and we're supposed to determine the source of it, and what we did was tried to do a comprehensive sampling scheme to see if we have another source or is this catching the edge of a bigger problem. And, pretty much, what we're trying to say is we caught the edge the Hadnott Point plume, which we're already addressing with two pump-and-treat and continuing to try to do pilot studies to treat that problem. We're just trying to say this is a continuing source of the overall groundwater problem.

MR. JEROME ENSMINGER: Were there any samples

taken in the industrial area of the -- the industrial dry cleaning plant?

MR. MATT LOUTH: I'm sorry; are you talking about OU25 or --

MR. JEROME ENSMINGER: No, no; the industrial site, where they dry clean sleeping bags and things like that for the Marine Corps.

MR. MATT LOUTH: I'm not aware of that site. Is anybody else aware of that site?

MR. RANDY McELVEEN: Where is it located?

MR. JEROME ENSMINGER: It's in the industrial area.

MR. MATT LOUTH: They pretty much sunk the industrial area with samples and monitoring wells, so it's a good chance that it has -- now -- and, if you can locate that facility for us, that'd be great. We might be able to find, you know, find the source from that facility itself. But this is such a bad area. Everyone knows we had our fuel farm over there, and we had it taken out, and that thing was leaking for years. So the UST site actually has a remediation system in here, too, air sparge soil vapor extractions. They actually pump out fuel every day out of there to address the soil vapor extraction or something like that. I can't remember what they call it.

MR. RANDY McELVEEN: At this site they did a

cleanup after --

MR. MATT LOUTH: At this site, yes. They actually do have -- Building 1613 is actually a UST site --

MR. DANIEL HOOD: POL constituents.

MR. MATT LOUTH: Right -- for the pol constituents. But, like Dan said, once we found some type of chlorinated solvent in there, it was turned over to us. We thought it was another site. But it turns out, through our samplings, it's probably just the edge. And this is -- through all our samplings this is what we're trying to convey here. It's the entry Site 78 right here, and we're gonna address any TCE residuals out there to Site 78.

MR. RANDY McELVEEN: The further we go away from Site 94, the worse it got.

MR. JEROME ENSMINGER: Just for my curiosity, what were the highest readings at this site?

MR. RANDY McELVEEN: I believe they were right around the area. It was low. In the 10s, 20s and 10s --

MR. JEROME ENSMINGER: What was your highest?

MR. MATT LOUTH: Right around 100 was the highest, ppb.

MR. JEROME ENSMINGER: That's not that low.

MR. RANDY McELVEEN: That was the gas station -- at the UST site there wasn't.

MR. JEROME ENSMINGER: You're talking about Site

94? The highest was 100?

MR. RANDY McELVEEN: In the groundwater.

MR. MATT LOUTH: In the groundwater, right, parts per billion. The whole area is -- there's a definite impact for Site 78.

MR. DANIEL HOOD: We have a regional groundwater problem in this area. I mean, we're not even gonna try to say we don't have that. That's why we have two pumps treating and had the pilot studies and we're actually in the middle of another trying to figure out what else we can do in the Hadnott Point area to further speed up the remediation of this area.

MR. RANDY McELVEEN: It's very scattered, too. I remember you can go -- there was no making any sense of it. It's like somebody dumped something over here and it jumped up a little bit and --

MR. JEROME ENSMINGER: Well, DOTs are heavier than water, so there would seem to be no point -- and that's where you would find your heaviest pockets of the stuff. It's 100 parts per billion. And you say that's standard?

MR. MATT LOUTH: No. We're saying that's standard for this area, OU1, is what we're saying. We're not trying to say that there's not a groundwater issue in this area. We're fully admitting there's a groundwater issue in this area. But site 94 did not contribute to this. That was

our overall -- we're trying to see did we have another source problem or was this just coincidence that the UST program happened to catch the edge of one of our plumes.

MR. JEROME ENSMINGER: Well, it alarms me that you get 100 parts per billion and it doesn't set off any alarms.

MR. DANIEL HOOD: Oh, it does.

MR. ROBERT LOWDER: Oh, it does, for OU --

MR. MATT LOUTH: Yeah, it does for OU1. However, we're looking at Site 94 in the process is an activity that took place at Site 94, which was more petroleum related in conjunction with servicing the gas stations. There is a groundwater problem within OU1 that is definitely impacting underneath Site 94, but the activities of Site 94 do not contribute to those correlated problems is what we're saying. That's what we're saying, yes. There's a groundwater problem there that's an unacceptable risk that's being addressed under OU1 for Site 78. However, this problem did not come from Site 94, it came from OU1. So our recommendation of no further action is only for Site 94 as the activities related to the gas station activities. The unacceptable risk of groundwater is being assessed onto Site 98 --

MR. RANDY McELVEEN: 78.

MR. MATT LOUTH: -- as Daniel says -- Site 78 --

as Daniel indicated, there's a pump-and-treat in place and also a technical evaluation's being done to look at additional remedial alternatives to speed up the process because there is an unacceptable risk of groundwater --

MR. DANIEL HOOD: And we have done vapor intrusion in the Hadnott Point area because it was one of the areas where there were vapor problems. So then the Navy did vapor intrusion studies on the buildings in the area.

MR. RANDY McELVEEN: And this area will be monitored and treated under OU1 and we found that as you moved away from the site and went deeper that you wouldn't find the stuff, which is an indication that you're not continuing. You're at the end or edge of the plume. The bottom line at this site, we're definitely not forgetting about this contamination, but it was slight compared to some areas.

MR. CHRIS BOZZINI: I wish we would have brought a slide of the 78/40, so we could put it up here for you, but we didn't think about that ahead of time; sorry. We can get you a copy. There's plenty. We've spent a lot of time and effort on 78; we will continue because that's our biggest site and always has been.

MR. RANDY McELVEEN: Yeah, we just finished the oxygen releasing compounds pilot study on one in the south end -- no, the north end, and in the south end we did the

HRC's oxygen release pilot studies to see if we could help reduce those concentrations a little faster in that area.

MR. JEROME ENSMINGER: Okay.

MR. RANDY McELVEEN: You'll find those studies contained there on that web page, Jerry. They're all together in the record.

MR. MATT LOUTH: So I'd say here regarding the risk assessment that was done on the 94 data set, looking at the data from a risk perspective, the surface soil, subsurface soil are both acceptable for ecological and human health risk. Groundwater was unacceptable for human health but acceptable for ecological. An unacceptable risk from the groundwater was -- a portion of it was attributed from Site 78, migrated on to Site 94. Based on the data set that was collected during the RI and also looking at, you know, the data collected from Site 78 from the snapshot groundwater sampling event, the partnering team, the Navy, in conjunction with the base, the EPA and the State, agree that there was no unacceptable risk from the human health/ecological standpoint that's attributed to the activities at Site 94. And, like we had discussed, the coordinated VOCs identified that are posing unacceptable risks are from the adjacent Site 78 that are being addressed through groundwater pump-and-treat and monitoring natural attenuation under the ROD for Site 78. So based on this, the preferred alternative, the partnering team

came up with no further action for Site 94 because the activities did not contribute to the unacceptable risk to groundwater. So no response actions will be performed at Site 94. It'll be addressed on Site 78. And there'll be no restrictions on the land use or exposure for Site 94. And, basically, we're here tonight -- we started the public comment period for Site 94 back on February 1st and it runs through March 3rd. The public notice was published in the Jacksonville Daily News on February 1st and The Globe on February 2nd to solicit comments from the public on the proposed remedial action for Site 94. As we indicated with Site 93, the admin record is at this website. Click on the website link, go to admin record and type in Site 94, and the documents related to Site 94 come up. Once again, if you have comments or questions, please, feel free to contact Gena Townsend from the EPA, Randy McElveen from the State, Dan Hood from the Navy, and Bob Lowder from the base. The path forward, the public comment period will run through March 3rd, and, basically, the public comments will be reviewed, recorded and a responsive summary will be conducted. If modifications from the public comments warrant the proposed remedy to be reassessed, additional public comment periods will be solicited. Basically, the partnering team comprised of the Navy, the base, the EPA and the State will make the final decision on the remedial approach for Site 94 after all

of the information has been reviewed during the public comment period. A Record of Decision for Site 94 will be drafted, and the responsive summary will be included in the Record of Decision for Site 94. When the Record of Decision is completed and signed, the public will be notified and it will be added to the administrative record via the website. Okay. Yeah. This goes through, as far as having community participation within the public comment period and decision-making, which is done through the RAB, soliciting the RAB input, the community involvement, the public meetings or community relations plan for the base, and then gaining community assessments for the proposed remedial action to the public comment period. Any other questions, comments regarding our path forward for Site 94? All right. Thank you very much.

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MEETING ADJOURNED AT 7:40 P.M.

STATE OF NORTH CAROLINA)

) C-E-R-T-I-F-I-C-A-T-I-O-N

COUNTY OF PITT)

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